THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
Wayleaves for Telephones	81
The Colliery Exhibition (*illus.*) (*continued*)	83
The Electrical Equipment of Overhead Travelling Cranes (*illus.*)	84
Polyphase Converting Sub Stations	87
Boiler House Economies	89
Correspondence	89
Parliamentary	90
Legal	93
Business Notes	94
The Neepsend Power Station of the Sheffield Electricity Department (*illus.*)	99
Electricity Supply Accounts	108
City Notes	108
Stocks and Shares	110
Share List of Electrical Companies	111
Market Quotations	112
Electric Tramway and Railway Traffic Returns	112
Measuring the Irregularity in Speed of Engines (*illus.*)	113
The Municipal Electrical Convention:—	
Polyphase Sub-Stations: Their Equipment and Working (*illus.*)	113
Boiler House Economies	116
Simple Stories.—V.	118
The Dissociation of Cupric Sulphate and the Decomposition of Anodes of Copper	118
Our Legal Query Column	119
National Telephone Co.'s Staff Dinner	119
New Patents Applied For	120
Published Specifications	120

THE

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WAYLEAVES FOR TELEPHONES.

IN the clamour for better telephonic facilities in the Metropolis and elsewhere, the fact is sometimes lost sight of that telephone companies experience considerable difficulties in obtaining the necessary wayleaves for their wires. Unlike the railway company, whose directors can obtain the sanction of Parliament for the compulsory acquisition of land, the telephone company are often compelled to come to terms with householders and others over or near whose property the company require to place their wires. The report of an interview between the representative of the *Daily Mail* and one of the officials of the National Telephone Co., which appeared in that journal on June 10th, shows the difficulties which the company experience in procuring the necessary consent. Thus it is said that:—"The owners of a hen-house sought compensation because, after telephone wires had been laid across the top of the house, the hens laid fewer eggs." Again, "An irate property owner recently tied a group of offending telephone wires to a dog kennel containing a large dog, and then invited the telephone men to remove them." We venture to quote one instance, however, to show that the telephone company can sometimes overcome the householder's prejudice. Our daily contemporary says:—"The wayleave officer was threatened by the owner that he would kick him out of the place. The officer asked if he could get the wayleave after the kicking. The owner said, Yes. The wayleave officer prepared to be kicked, but the position struck the owner as being humorous, and the wayleave was obtained."

That the law permits the owner of property to adopt a wholly unreasonable attitude appears to be clear from a consideration of the Telegraph Acts. Sec. 21 of the Telegraph Act, 1863, provides (in effect) that the company shall not place any work by the side of any land or building, so as to stop, hinder, or interfere with ingress or egress to or from the same, or place any work under, in, upon, over, along, or across any land or building, except with the previous consent in every case of the owner, lessee, and occupier of such land or building. There is an important proviso in the case of any wires placed within the limits of the County of London, any city or municipal borough, or any town of more than 30,000 inhabitants. The section goes on to provide that if in any of these places the highway authority has consented to the placing of wires in, upon, over, along, or across any street, this consent shall be sufficient authority for the company (except in the case of land belonging to the Crown) to place and maintain a telegraph wire (which term includes telephone wire) over, along, or across any building adjoining to or near the street, or over any land not being building land, or a garden, or pleasure ground. This right, however, is subject to the following conditions:—The company must publish a 21 days' notice, stating that they have obtained the consent, an

indicating the course of the proposed line. If the line goes over any dwelling house it must, unless the owner consents, be placed at a distance of not less than 6 ft. above the roof. Further, if the owner desires to increase the height of his house, the company must not allow their wires to interfere with the alterations. Finally, the company must make full compensation to the owner, lessee, or occupier of any land or building over, along, or across which the company places a telegraph, *and which may be shown to be prejudicially affected thereby*. The compensation is to be settled, in case of difference, by arbitration under the Land Clauses Acts.

Broadly speaking, the effect of the above provision is that in the metropolis and other large towns, posts, &c., may be erected on the roofs of houses, but subject, in all cases, to the payment of compensation. We say in *all cases* advisedly, for the words printed in italics admit a claim for interference with the barest legal right. Thus, it is a technical trespass to stretch a wire over a man's land, although the wire may be placed at such a height as not to interfere in the least with the ordinary uses to which he may put his premises. Again, the placing of a pole in front of a man's house may involve a claim of compensation. In the case of R. *v.* United Kingdom Electric Telegraph Co. (2 B. and S. 647), the defendants, for the purpose of profit to themselves, placed telegraph posts upon a highway with the object and intention of keeping them there permanently, and did permanently keep them there, such posts being of such sizes and dimensions and solidity as to obstruct and prevent the passage of carriages and horses, or foot passengers. It was decided that the defendants were liable to be found guilty upon an indictment for a nuisance. It was also decided that if the posts were not placed upon the hard or metalled part of the highway, or upon a footpath artificially formed upon it, or even if sufficient space was left for the public traffic, the defendants were still liable to conviction.

The foregoing statement will have made it plain, that although the telephone company may have compulsory powers in a large town, those powers cannot be exercised without payment of what may well be fanciful claims for compensation.

A reference to Section 22 of the Act of 1863, shows that in rural districts and small towns the problem which is presented to the telephone company is still more formidable. That section provides, in effect, that in these districts the company shall not place a telegraph above ground, or a post, within ten yards of a dwelling house, or place a telegraph above ground across an avenue or approach to a dwelling house, except subject and according to the following restrictions: They must obtain the consent of the occupier, lessee, or owner; the consent of an occupier being effective only during the continuance of his occupation. On the termination of the occupation of any occupier, the lessee or owner entitled to possession, if he does not consent to the placing of the telegraph or post, may give notice to the company requiring its removal, and the company must remove it. If this provision as to removal is not carried out, the company may become liable to a penalty not exceeding £5 per diem.

It is easy to see that a very powerful weapon of obstruction may thus be placed in the hands of owners and occupiers. They can, apparently, refuse consent from mere caprice, and an owner or occupier, upon coming into possession of premises over which there is a wire suspended, may arbitrarily require its removal.

We think that the difficulties which the law places in the way of a company which is desirous of providing an adequate telephone system, should be appreciated by those who are so ready to criticise. Unless the power to acquire wayleaves compulsorily is conferred by Act of Parliament, we do not see how a complete system of telephone communication can ever be established.

Ventilation and Overcrowding.

At a time when under the depressing influence of vanishing dividends the wail of the railway director is continually with us (although not more continually than the responsive suggestions of the enthusiast who would have us believe that in electrification we have a salve for all the wounds inflicted by unkind tramway competition), it behoves us to treat with some reserve the wonderful traffic-handling powers usually attributed to the modern panacea for railway ills under all and sundry circumstances.

Not that we can quarrel with electrification in principle, but its application under special conditions, and more especially those involved in the regeneration of underground railways, may involve the upsetting of many prematurely accepted methods.

We have grown so accustomed to crediting our old underground steam routes with everything evil in the way of overcrowding, bad ventilation, and inefficient services, and also to swallowing the no doubt well-intentioned statements of the electrifying enthusiasts as to the coming modification of these evils, that it comes as something in the nature of a shock when we hear of passengers on the recently electrified Liverpool and Southport line complaining of the badly ventilated carriages and of obstructed egress and ingress.

Involuntarily we are tempted to ask whether this does not confirm our latent suspicions of the somewhat too rosy programme, sketched out for our benighted, though indispensable underground by the reforming enthusiast? Whether the roomy electrical cars provided for in the coming conversion, are going to be so efficacious in the matters of ventilation and overcrowding as the much-maligned ordinary pattern of railway coach? In fact, whether the experience gained up to the present on electrified railways, working under far less strenuous conditions than exist on the Metropolitan and District routes, does not justify a reconsideration of electrical train design as at present adopted?

To sum the matter up, we have on our underground routes, platforms which cannot reasonably be lengthened, and which effectively limit the length and carrying capacity of the trains; and if we are to add to this, during the periods of heavy traffic, lengthened stops at the many busy underground stations due to the difficulties of getting into and out of the new coaches, and consequently to obtain no great increase in the average speed and number of trains, just when they are wanted, and further to experience no greater opportunities of breathing pure air than at present—we cannot reasonably refrain from asking whether the much vaunted prospective amelioration of our lot is not vanishing into thin air; in fact, whether the proverbial "bread" of comfort is not going after all to turn out a "stone" of continued discomfort with electrical trains of the pattern at present in vogue.

THE COLLIERY EXHIBITION.

(*Continued from page* 47.)

Air Compressors. — Air compressors are now extensively used in colliery work, and several fine examples of this class of machinery were shown. The Ingersoll-Sergeant compressor has been already referred to, and we show herewith a section through the cylinder of their piston inlet type of machine, fig. 8. Next to sound mechanical construction, which applies as much to compressors as to steam engines, the arrangement and design of the valve gear is an all-important item. The areas of the inlet and outlet ports must be as large as possible, and the valves themselves must be light in weight, and so located as to reduce the clearance to a minimum. At the same time, it should not be possible, in the event of fracture of the valve, for any part to be drawn into the cylinder, the results of which would, of course, be disastrous, owing to the necessarily small clearance between the piston head and the end of the cylinder. With valves of the poppet type, the metal should be specially selected, and must be of a type that will not easily crystallise, due either to constant heating or the vibration to which they are subjected.

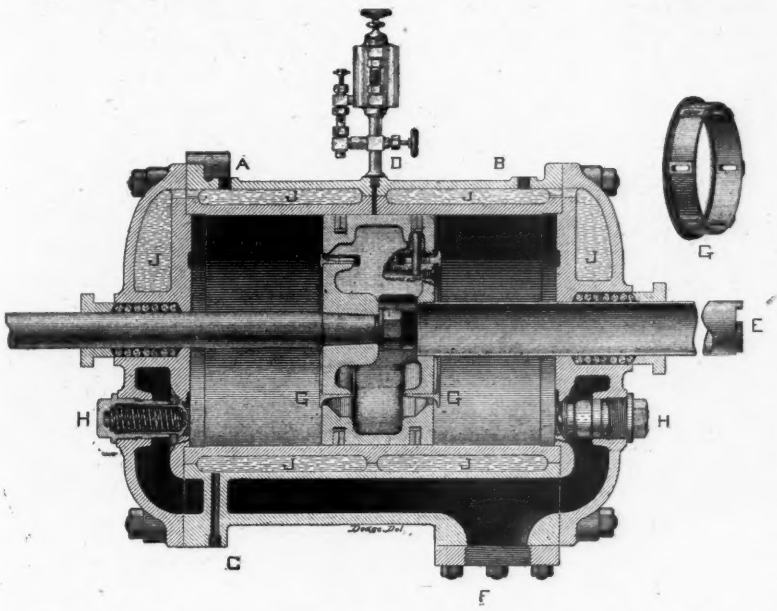


Fig. 8.—Section through Cylinder of the Ingersoll-Sergeant Compressor. Piston Inlet Type.

The valve gear of the Ingersoll-Sergeant machine is clearly shown in the illustration. The discharge valves, H, are of the poppet type with internal springs, and the whole of the valve box can easily be drawn from the outside. The two inlet valves are located in the piston, and are indicated by the letter G. These consist of rings, which fit loosely in grooves in the piston head, which contains a large air space between the two faces. When the piston is in motion the valve on the leading end is kept closed by the air pressure, whilst that on the suction side opens immediately the valve begins to move, allowing air to fill the cylinder through the hollow piston tail rod marked E. On the return stroke, the valve on the other side is left behind by the piston, the one on the leading or pressure side being pressed in by the air. There are no springs, and as the air passages are large there is no throttling of the incoming air, and, of course, no chattering, which is a common feature of the poppet type of valve. The speed of the piston does not affect the motion of the valves, which have been tested down to 9 r.p.m. A shallow circular groove is turned in each cylinder head to receive the projecting part of the valve ring in order to minimise the clearance between the piston head and the cylinder cover. A set of these valves were used on a 16¼-in. × 18-in. Ingersoll-Sergeant air compressor at the Central 1A Tunnel, Penn., and afterwards at the Niagara Falls for the Cataract Construction Co., running altogether 4½ years night and day, or an equivalent of 9 years' service on single shift. It is claimed that there is a loss of from 5 to 10 per cent. with poppet inlet valves, when the air is started from rest at each stroke, which loss is not present with the piston inlet type.

In driving air compressors by steam it is not a difficult matter to control the steam valve by the air pressure, and so vary the speed of the engine to suit the requirements. With electric motors the speed regulation is not so simple, and when driving by three-phase motors, there is no economy in varying the motor speed to suit the air supply. In some machines air relief valves are provided, by means of which air is discharged into the atmosphere when the maximum pressure is exceeded. This, however, does not tend to economy, as the air is compressed whether it is used or not. To meet these objections an unloading device is provided, when necessary, on the Ingersoll-Sergeant machine, which consists of a bye-pass connecting the two sides of the piston together, so putting them in equilibrium when the pre-determined pressure is exceeded. The piston is then balanced at full pressure, the air flowing easily from one end to the other by piston displacement; the pressure holds the inlet valves, and the only power absorbed is that required to run the machine when loaded. This is a very useful device for electric driving, but more particularly for three-phase work.

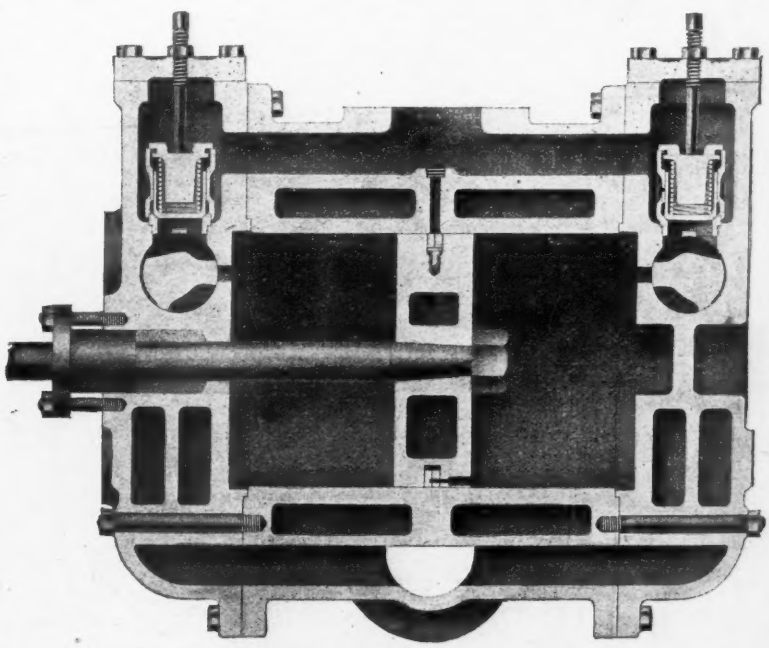


Fig 9.—Worthington Air Compressor. Section through Cylinder, showing Valve Gear.

D

The Worthington Pump Co., Ltd., had an imposing exhibit, including air compressors and pumps, the latter being of both the ram and centrifugal types. Among other exhibits was a steam-driven cross-compound two-stage air compressor having steam cylinders 11 in. and 17 in. diameter by 18 in. stroke, and air cylinders 16 in. by 10 in. diameter with the same stroke, rated to deliver 630 cb. ft. per min. at 100 lbs. pressure when running at 150 r.p.m. In their earlier types of machine the Worthington Co. used mechanically-operated valves driven from an eccentric on the engine shaft. Whilst this form of gear possesses considerable merits, its principal objection lies in its want of elasticity, and it is only applicable when a fairly constant discharge pressure can be counted upon. This can be met by means of an automatic regulating gear which, of course, adds to the cost and number of the moving parts. On the other hand, the poppet valve, whilst perfectly automatic and elastic in its operation, is open to the objections already mentioned above, namely, noisy action and wear due to the impact of the valves on their seating on the reversal of the stroke. This trouble, obviously, becomes more serious in high speed machines. To overcome the difficulty, some makers, including the Worthington Co., adopt in some of their machines mechanically operated inlet valves and poppet discharge valves. This, however, is only a partial solution of the difficulties, and the Worthington Co. have now introduced a new type of valve gear, which is claimed by them to accomplish noiselessly and effectively the results which it has been sought to obtain by the many mechanically assisted poppet valve designs found in other machines. Our illustration (fig. 9) clearly shows the latest type of Worthington valve gear. This is a combination of the poppet valve and the mechanically operated rotary valve. The opening of the discharge valve, which is the variable event in the cycle, is effected by means of the poppet valves. At the end of the stroke, however, the discharge port is mechanically closed by means of the rotary valve shown beneath the poppet valves. This has the effect of retaining under the poppet discharge valve a cushion of air under receiver pressure, and permits the poppet valves to come down gradually on their seatings during the entire return stroke, all tendency to violent and noisy impact being removed. A small clearance combined with large port areas is retained in this design, and it will be noted that the conditions lend themselves to noiseless working, even with comparatively high speeds. The poppet valves are capable of adjustment from outside by means of screwed set bolts passing through the valve cover. The valves, it will be seen, can be drawn without disturbing the cylinder covers. The two-stage machines are provided with tubular coolers between the high and low pressure cylinders, these coolers being constructed on identical lines with the best type of surface condenser, the air passing over a nest of small brass tubes through which water circulates. The cylinders are also water-jacketed, as shown in the illustration. In the steam-driven machines, the steam valves are either of the Meyer or the Corliss type, depending on the size and speed. The Meyer gear is shown in fig. 10. As is probably well known, the distinguishing feature of this gear lies in the use of a pair of auxiliary valves working on the back of the main valve, and actuated by an independent eccentric. The "cut-off" is determined by their relative positions, which can be adjusted by means of the hand-wheel shown at the right of the illustration. The valves are held on the spindle by a right and left-handed thread respectively, the square end of the spindle moving to and fro in the spindle of the hand-wheel. An index plate mounted on the wheel bracket indicates the point of "cut-off."

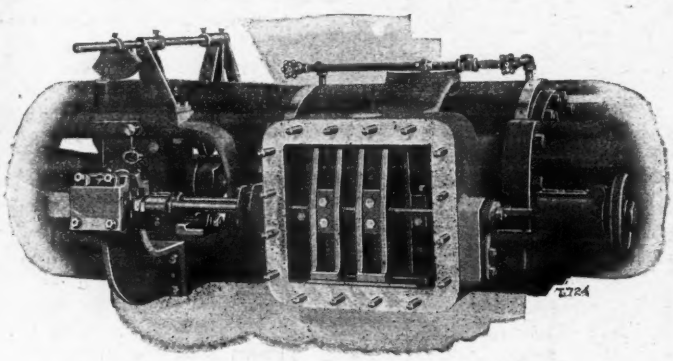


Fig. 10.—Meyer Valve Gear on the Worthington Steam Driven Compressor.

A very interesting type of air compressor was that shown by the Power Plant Co., Ltd., at Messrs. Scott and Mountain's stand; this is a two-stage compressor, with a single cylinder, and a differential trunk piston, as shown in the illustration (fig. 11). In the figure the two valves shown at the top are delivery valves, the two at the bottom being suction valves. On the forward stroke of the piston, air is drawn into the piston through the inlet valve at the back of the cylinder — that is, the lower left-hand valve shown in the figure. On the return stroke, the air is compressed at the back of the piston, and discharged through the valve immediately above the suction valve. The air then passes to the suction valve on the right-hand bottom side, where it is delivered into the space between the trunk piston and the cylinder wall, the area of this space being smaller than the area at the back end of the piston. On the forward stroke, the air undergoes its second stage of compression, and it finally discharges through the valve at the top right-hand side of the illustration. The cylinder is water jacketed, and in addition to this an inter-cooler is used for pressures exceeding 100 lbs. This forms the connection between the delivery and suction valves of the high and low-pressure ends. The valves are very easily accessible, and can be opened up in a few minutes. They are of very simple construction, consisting simply of a disk of indestructible saw-blade steel, resting on a grid seating. They are very light, and are practically frictionless, enabling the machine to work at high speeds. As the machines are provided with heavy fly-wheels, the torque is fairly uniform, rendering them very suitable for electrical driving.

(To be continued.)

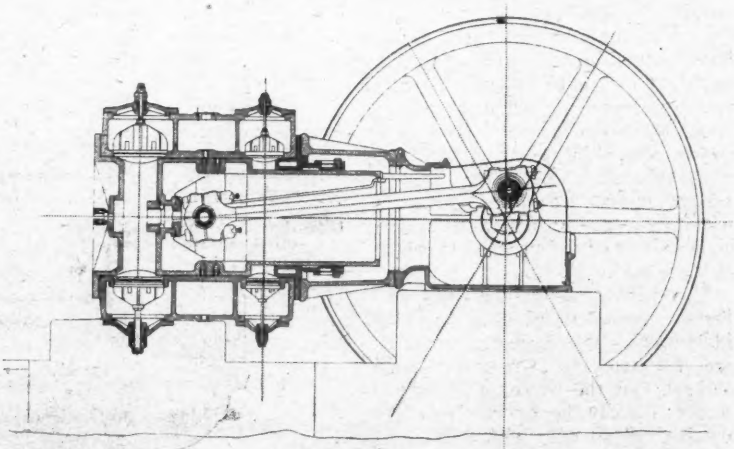


Fig. 11.—Power Plant Co.'s Compressor. Section through Cylinder.

THE ELECTRICAL EQUIPMENT OF OVERHEAD TRAVELLING CRANES.

By J. W. Warr.

The electric overhead travelling crane, with separate motors for each motion, is now giving unqualified satisfaction in engineering works, foundries, central stations, shipbuilding yards and dockyards, &c. Experience has proved that this type

of crane is much more convenient in use, and the load more easily manipulated than with the single motor-driven crane. The former is no doubt more costly to construct, but the absence of the complicated gear changes and reversing motions necessary in the latter, together with the convenience, simplicity, and saving of time associated with the former, soon repays the extra capital expenditure.

The writer cannot remember seeing a descriptive account of the wiring and fitting up of these cranes in a technical journal, and as they are coming more into use year by year, many readers will no doubt be interested in an explanation of the electrical part, and also in the drawings of the wiring and switches, &c.

Fig. 1 represents the wiring, switches, and connections of a 50-ton overhead travelling crane for continuous current being one out of 40 which the writer occasionally had charge of some time ago. There are three series wound motors

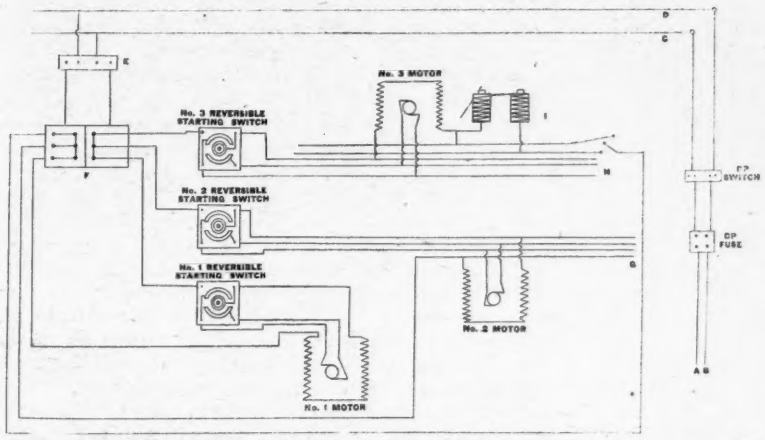


Fig. 1.—Wiring Diagram, 50-ton Overhead Travelling Crane.

for working the three motions, viz., the longitudinal traverse, with the motor fixed at one end of the cross traverse girders for moving the crab and these girders along the main girders, the cross traverse, for moving the crab along the cross traverse girders, and the hoisting motor for raising and lowering the whip, both motors being fixed on the crab. The size and speed of the motors are :—

No. 1. Longitudinal traverse motor,	20	B.H.P.,	500	revs.,	220 volts.
„ 2. Cross „ „	8	„	750	„	„
„ 3. Hoisting „ „	20	„	500	„	„

There are some cranes fitted with a fourth motor for raising and lowering a small whip, usually smaller than the other hoisting motor. This motor is omitted in some cases, the drum of the small whip being thrown into the gear of the one hoisting motor when required, and the drum of the large whip put out of action. The arrangement is worked by a clutch operated by a lever outside the cage. All the motors are of the totally enclosed type, and are fixed so as to allow of easy inspection and easy access to all parts for repairs.

On an extension of the armature shaft of the hoisting motor is fitted a band brake, to keep up the whip in any desired position. Spiral springs hold the band tightly gripped in position on a drum, and a large electro-magnet in series with the motor draws an armature on to its poles for releasing the band. The magnet and motor work simultaneously. If the whip suspends a heavy weight, and it is necessary to lower slowly, the two-way switch shown in the drawing (fig. 1) can put the magnet out of action, in which case the motor has to work against the brake. Another method is to lower the load by the motor, or by hand by a lever attached to the armature of the electro-magnet fixed in the cage. In the former case the band is released, and the whip and load lowered by the simultaneous action of the magnet and motor, and in the latter case by the hand lever releasing the band, causing the motor armature to rotate. In either case, care must be taken when lowering the load, as the armature may be damaged by running at too high a speed.

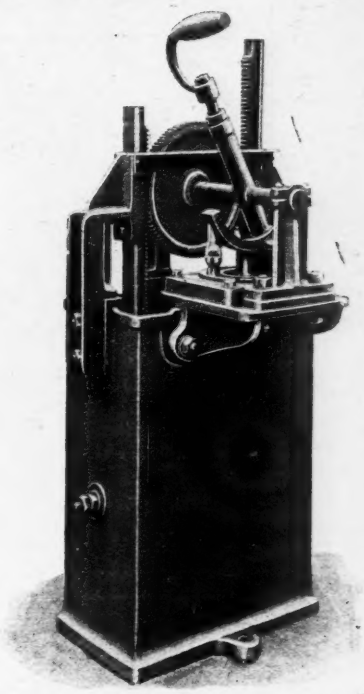


Fig. 3.—Liquid Reversing Crane Controller.

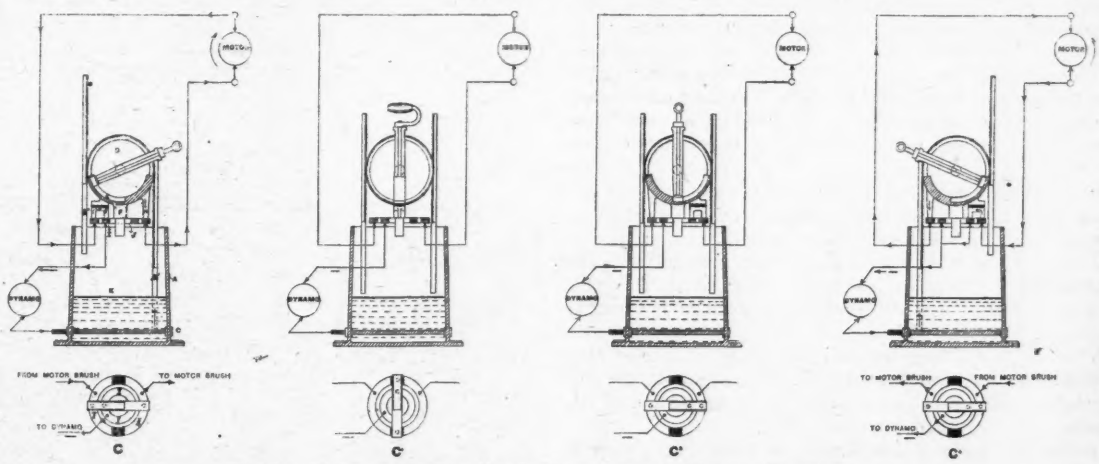


Fig. 2.—Diagram showing Liquid Controller in Various Positions.

For starting the motors the ordinary controller can be used, but liquid switches are largely in favour, as they take up less space, have fewer contacts to keep in order, wider variation in speed, and repairs are more easily and quickly executed. There is no fear of the liquid splashing, as the track is even, and the only occasional repairs are new dippers

and bars, and new bushings in the tank. The plunger contacts may require periodical inspection. The tank should be cleaned out occasionally owing to the electrolytic action on the iron.

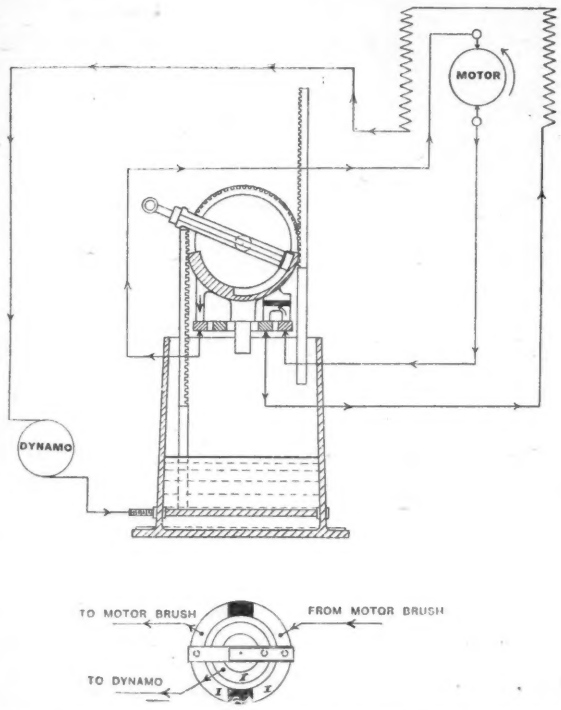


Fig. 4.—Diagram of Liquid Controller Connections to Motor.

The starting switch shown in fig. 2 is of the liquid reversing type, manufactured by Messrs. Vaughan and Son, Ltd., crane builders, Manchester. Fig. 3 is from a photograph of the switch, and gives a better idea of its construction. At C (fig. 2) the different parts of the switch are lettered as follows :—A is a cast-iron tank to hold the electrolyte ; B^1 and B^{11} are the racks and dippers ; C is the short-circuiting bar ; D is the pinion to which is attached the handle mounted on a spindle supported on pedestals and bearings at each side of the tank ; E is a swivel-jointed brass guide fixed in the centre of the slate J, which allows the handle to make a circular movement, and can be placed either vertical, as in sketches C^1 and C^2, or at the angles in sketches C and C^3 ; F contains the set screw making the swivel joint ; G is the brass bridge and plungers (the latter being made similar to the plungers of a lamp-holder), insulated by ebonite from the guide ; H is an extension of the guide, forming the other plunger ; I is the contact rings shown at the foot of each sketch, the outer ring being divided and insulated from the others by ebonite ; K is the electrolyte.

The short-circuiting bar is insulated by ebonite or fibre bushings and washers from the tank, in the event of fastening the latter to ironwork or earth. The upper portion of the switch is also insulated from the tank.

Before explaining the working of the switch, a glance at fig. 4 will be necessary, which shows the connections to the motors ; C^1 in fig. 2 represents the switch ready for starting the motor ; C^2 shows the guide and plungers in contact with the inner ring, to which one end of the series winding of the motor is attached, and the two outer or half rings to which the armature leads are connected ; C^3 shows the dipper short-circuited to the bar through the electrolyte, thus bringing the handle and pinion in the position shown, and causing the armature to rotate counter clockwise ; C shows the position of the handle and pinion for clockwise rotation. The direction of the current in both sketches is indicated by the arrows. Underneath the slate suitable lugs are fitted for sweating-in the cables.

The electrolyte in the tank consists of caustic soda and water, which can be made up in the tank ; and if on trying to start the motor by slight immersion of the dipper, it refuses to run slowly, sufficient caustic soda has not been put into the water. This can be proved by nearly short-circuiting the dipper, when the motor will run at full speed. The presence of too much alkali will be shown by sharp firing and crackling on the immersion of the dipper. When suitable proportions are employed a white foam appears on the surface of the electrolyte, together with a gentle effervescence.

A good arrangement of the main leads for supplying current to the motors, is to have copper bars run along the main girders, supported on brackets insulated from the iron-work by ebonite or fibre bushings and washers. The main collectors are constructed with swivel or ball joints to make sliding contact on the flat surface of the bars shown in fig. 5 [A^1 and A^{11}], and are attached to two arms fitted behind the cage, from which the cables, sweated into lugs, are taken to the three-way distribution board shown in fig. 1. It is as well to mention here that starting switches, distribution board, emergency switch, &c., are all placed inside the cage for easy access by the driver. For the hoisting and cross traverse leads, which are run from end to end between the cross girders, ordinary trolley wire with Brooklyn or bobbin insulators can be used, as very little sag will be found in the comparatively short span. The collectors for these leads can be of the ordinary hook-shaped type as shown at B^1 and B^{11}, fig. 5, and are mounted and insulated on iron suspenders from the crab, to which the cables are fastened by lugs on the two motors. The suspenders and collectors are adjusted so as to slightly lift the wire, which rests in the bend of the collector in order to make good sliding contact.

Of course the ordinary trolley wire and collectors can be used for the main leads, but it will be necessary to use insulators with a broad surface for the wire to lie on, the collectors being adjusted to raise the wires and clear the insulators as they pass, when the crane is in motion.

The wiring of the crane in fig. 1 shows only the slate and ring contacts of the switch for clearness. A B are the cables supplying current to the main leads C D, which are usually run in casing up the wall or a stanchion at the most convenient end of the main girders, the D.P. fuse and switch being fixed within easy reach of the floor. E is the D.P. emergency switch ; F is the distribution board, one side being provided with fuses and the other side with an ordinary bus-bar for the cables to the switches. G and H are the bare leads for

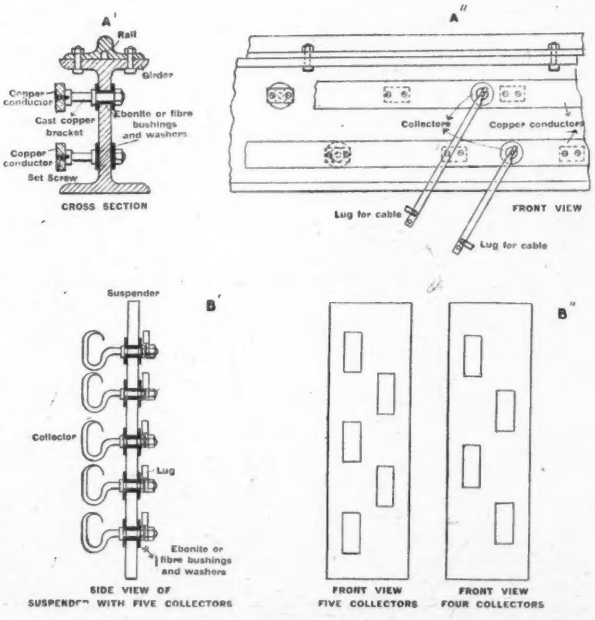


Fig. 5.—Arrangement of Leads and Collectors.

the hoisting and cross traverse motors. The longitudinal traverse motor being stationary does not require bare leads. I is the electro-magnet in series with the hoisting motor, which it will be noticed requires an additional bare lead on account of the two-way switch.

An incandescent lamp and tumbler switch should be installed in the cage, also a portable hand lamp and

flexible wire long enough to reach to any part of the crane, should any fault occur at night. The supply for these should be taken from the main leads, and not from the distribution board, as the emergency switch in the cage cuts off the whole of the supply to the motors on the crane in the event of a fault.

The following articles will be found useful to keep on the crane along with the ordinary tools :—A long cord and hook to reach from the top of the crane to the ground level for hauling purposes, a large syringe for supplying the tanks with electrolyte, oil, waste, and a bucket of water, three 8-in. hand parallel files (dead smooth, smooth, and second cut), bushings for tanks, &c., and fuses.

In order to minimise faults, it is essential that the driver should keep all working parts clean, and the motors and switches, &c., should daily be inspected by a competent person.

POLYPHASE CONVERTING SUB-STATIONS.

The paper read by Mr. Pearce, of Manchester, on the above subject before the recent meeting of the M.E.A., while not remarkable for novelty, is none the less instructive and worthy of attention. As will be seen from the abstract begun in our present issue, it deals with the choice of equipment for given service conditions, with the characteristic properties of the various equipments available, and with the performance and working of each of the three types of sub-station converter in question. The author's reasoning and conclusions agree entirely with those given by Mr. Eborall in his Institution paper on the same subject, read three years ago—namely, that given the necessity for conversion, the 25-cycle rotary converter should be employed for traction work, and the 50-cycle synchronous motor-generator for mixed traction and lighting, or for lighting only, except where the converting units are of small size, when the asynchronous motor-generator can be profitably employed.

Of the general correctness of these views there can be nowadays little doubt. When the quality of the pressure regulation on the direct-current bus-bars of a converting sub-station becomes a matter of secondary importance, the 25-cycle rotary, compared with either type of motor-generator, easily takes the first place as a sub-station converter, provided that it is operated from properly-designed generating plant. The total outlay on the sub-station is reduced to a minimum, not only because the cost of the electrical equipment is relatively the lowest, but on account of the smaller expenditure incurred in land and buildings. On the other hand, the efficiency of the conversion from polyphase to direct current is higher, especially at the lighter loads, and the overload capacity of the plant much greater—at any rate, as far as overloads of comparatively short duration are concerned. Traction work is consequently the proper sphere of utility of this class of machine, and actual experience with various rotary converter sub-stations, operating tramway and railway systems throughout the country, demonstrates in an unmistakable manner that its performance in connection with work of this character leaves little to be desired. It is, therefore, all the more remarkable that what are becoming the two most important electric tramway undertakings in this country (Manchester and London), have been laid out with motor-generator sub-stations. Certain it is that in these cases the ratepayers will derive no benefit from the heavy additional expenditure in this direction to which their technical advisers have committed them—an extra expenditure which is not confined to the initial outlay on the scheme, but which has its counterpart in the increased cost of the converted energy.

Notwithstanding the lower first cost and more efficient performance of the 25-cycle rotary compared with either form of motor-generator, it is not so well suited for lighting work, where the quality of the pressure regulation on the direct current side is of first importance after general reliability. The rotary converter possesses the inherent disadvantage in this respect of reproducing, on the direct current side, every variation in pressure which may occur on the A.C. side; variations in the engine speed, in the pressure of the generators, in the feeder and transformer drops, all filter through, and are reproduced on the direct current bus-bars, and, on the other hand, slight hunting, which would be of no importance on a traction system, immediately makes itself felt on a lighting network. On account of this, and also because the actual regulation of the pressure of rotary converters is neither so convenient nor so economical as with direct current machines, really successful lighting work on a large scale is only possible from them provided that large batteries are installed in the sub-stations, the highest class of attendant is employed, and the whole system is laid out with the greatest care. It is for this reason that the motor-generator sub-station is preferable for pure lighting work, or for those cases in which the lighting forms the bulk of the load; whether synchronous or asynchronous motor-generators are installed, the direct current side is entirely independen of what may happen on the A.C. side, except for variation in the frequency. And as far as the actual regulation of the direct current pressure is concerned, it is clear that this is far better carried out by the simple and well understood means usually employed with direct current machinery, than by the induction regulators or similar apparatus required by the rotary converter, which, it must be noted, are the seat of not inconsiderable losses when a long range of pressure regulation is required.

Without exception, those lighting undertakings in this country which have been compelled to adopt sub-station working for the whole or a part of their areas, have decided in favour of the motor-generator equipment for their sub-stations, and in our opinion, the decisions in question were undoubtedly right. From the points of view of reliability and cost of upkeep, there is little to choose between the two classes of equipment, and the real point to be decided, as far as such undertakings are concerned, is whether the advantages of a cheaper and somewhat more efficient sub-station are worth sacrificing in order to obtain a sub-station which conforms to every requirement from the pressure regulation point of view, and from the point of view of the general requirements of a lighting load. For such work the abnormal overload capacity of the rotary converter sub-station offers no advantages.

The relative merits of the asynchronous and synchronous motor-generator have been frequently fully discussed, and are well brought out in Mr. Pearce's paper. We think, however, that the employment of the asynchronous type should be limited to smaller sizes than 500 KW., first, because of the small air-gap; and secondly, because of the relatively low power-factor at the lighter loads. In a set of this size, the air-gap will not exceed 0·08 in. unless the power-factor is sacrificed and even with this air-gap the power-factor will not be greater than 88 per cent. at three-quarter, 84 per cent. at half, and 77 per cent. at one-quarter load, in the best 50-cycle induction motors it is possible to get. Taking, for example, such a system as that of the Metropolitan Co., in which no fewer than 18 motor-generators of 500 KW. are in operation, it is clear that, if these were asynchronous sets (which they are not), heavy lagging currents would always have to be dealt with, and that the air-gaps (and bearings) of the converting machines would require what, in these days, would be called an undue amount of attention. Our feeling in this matter is that the synchronous converter is generally the better of the two for sizes above 250 KW., and that in those cases for which larger sizes are nevertheless used, the slip-ring type of induction motor (referred to by Mr. Pearce), should give place to the motor with permanently short-circuited rotor, started up from the direct-current side. Large induction motors of the latter type are not only structurally preferable, but have somewhat better power-factors, and for this class of work there is nothing to say against starting them in this way—which, it may be noted, is being adopted by Mr. Chamen in connection with his large extensions at Glasgow.

In the remarks made above in connection with rotary converter sub-stations, it will be noted that the 25-cycle rotary has alone been referred to, for the reason that, in our opinion, the limit of successful operation of large rotary converters is reached at 30 cycles, or thereabouts, unless the power station generators are turbine-driven. Especially if the rotaries are of a size comparable with that of the engine-driven generating units, troubles with hunting and with the

commutation of the rotaries are to be feared, the extent of which will depend upon the lay-out of the system generally. Thus we regard a 1,500-KW. 50-cycle rotary, operated from low speed generating plant, for instance, as a piece of very poor engineering, from the sub-station point of view. Although such a thing does not for the moment exist in this country, it may do so if certain engineers, commendably anxious to retain the standard frequency, base their practice too much upon the good results which will doubtless be obtained with the large *turbine-driven* 33-cycle rotaries to be installed in the sub-stations of the District Railway.

From the point of view of the design of either class of motor-generator sub-station, the standard frequency of 50 cycles is all that can be desired; it is also a frequency that is in every respect suitable for direct arc and glow lamp lighting, while the frequency of 25 cycles is not. A lighting undertaking employing 50-cycle motor-generator sub-stations for supplying its principal areas, is consequently in a position to supply outside areas from the same generating plant directly with a three-phase distribution, and can thus avoid a comparatively heavy outlay on converting sub-stations for areas which would otherwise become unprofitable. Such cases as these are quite likely to arise before long in connection with several existing undertakings, and furnish an additional reason for the employment of motor-generator sub-stations in the main area.

A consideration of this last matter leads naturally to a question of considerable interest and importance. During the last few years several important lighting undertakings have converted their systems from alternating to direct current working, while others, compelled to employ alternating current for reaching distant areas, have, nevertheless, provided a direct current supply for their consumers; again, entirely new undertakings, compelled to employ alternating current transmission, have also arranged for direct current distribution. The question then arises—Is this wholesale conversion from alternating current to direct current really necessary, requiring as it does converting sub-stations, which are costly from every point of view?

In this matter we agree in principle with Mr. Ferranti, who has once more stated during the discussion on Mr. Pearce's paper, that he considers the prevailing practice of putting down sub-stations for supplying lighting areas with direct current, one which requires a great deal of justification, and that eventually a return will be made to an alternating-current distribution, pure and simple. Without going so far as to believe that, at the present time, a single-phase transmission and distribution meets all the requirements of the case, we certainly think that in a large number of cases, lighting undertakings are being unduly handicapped by the expensive and uneconomical way in which they are being laid out, or extended, with A.C. transmission and D.C. distribution.

We believe that with present-day knowledge and experience, a simple three-phase transmission and either polyphase or single-phase distribution would meet all requirements in the majority of cases, thus avoiding not only the heavy initial exepnse of motor-generator sub-stations, which are fully utilised for but a few hours daily, but also their upkeep, superintendence charges, and the conversion losses. In our opinion, Mr. Hammond has set an example in Dublin which should be followed, and we attribute a great deal of the present-day practice and tendency in putting down converting sub-stations for lighting work, to the fact that many engineers find it easier to follow the fashion in this matter than to study what is really best suited to the actual requirements of the case, and to take the responsibility for acting accordingly.

Although, at the moment, it cannot be said that the single-phase system presents the same advantages for the general distribution of lighting and power as polyphase systems, yet it must be admitted that Mr. Ferranti's prophecy—that a general return will eventually be made to single-phase—looks much more likely of fulfilment now than it did when first made, some four years ago. The older single-phase systems fell into disfavour for two principal reasons, namely, because of the insufficient development of plant, transformers, cable, and other material, and because of the lack of cheap and good single-phase motors. The general improvements made in the former during the last few years, together with the advent of properly compounded alternators and the commutator motor, will, in all probability, before long give single-phase systems a new lease of life.

Before leaving Mr. Pearce's paper, and the reflections to which it gives rise, it may be noted that we are not altogether in agreement with the author on one or two points. For instance, curves are given showing the approximate relative costs of the three classes of sub-station converter, in sizes ranging from 100 to 500 KW., all sizes of both classes of motor-generator running at 375 revolutions, while the speeds of the rotaries are not stated. This is naturally not a fair comparison, for the rotaries may have been running at higher speeds; again, it is not a practical condition to operate such a range of motor-generators at the same speed. It is, therefore, not to be wondered at that the three curves turn out to be straight lines (which they never are in practice), and that they show the cost of the synchronous motor-generator equipment to be over 50 per cent. dearer than that of the rotary converter equipment. There is, of course, a difference, but it is never so great as this: as a matter of fact, when the switch and regulating gear is reckoned in, it is of the order of 12—15 per cent., depending upon the maker. Mr. Pearce also states that three-phase generators are lighter, cheaper, and equally, or more, efficient than two-phase generators, but, as a matter of fact, there is no commercial difference in respect to any of these matters between the two. We agree with Mr. Pearce, that three-phase transmission is generally preferable to two-phase, but for other reasons, namely, greater simplicity in the switchgear and transmission lines, and smaller line losses.

Again, with regard to the step-down transformers for the rotaries, Mr. Pearce states that transformers of the forced draught type are easier to insulate up to 10,000 volts than are those of the oil-cooled type, and further, that three-phase transformers are inferior from the points of view of breakdown risks and the amount of spare plant necessary, compared with the use of three single transformers. Our experience in these matters does not agree with the statements of Mr. Pearce. In the first place, the oil-cooled transformer is easier to insulate than any other type, provided that good oil is used, and that the temperature of the oil does not exceed about 80° C.; the oil not only prevents any portion of the winding or insulation exceeding a certain temperature, but it effectually prevents static discharges, and also seals up faults of the pinhole variety that are sometimes the result of a rise in pressure on the system. The objection to oil-cooled transformers is due to the presence of the large masses of oil, and to the fact that repairs are sometimes difficult to carry out without re-winding the whole transformer.

As for three-phase *versus* three single transformers, we cannot follow the argument, which is certainly not justified in practice; the former can also be mesh connected, and one leg can be cut out in case of need just as readily as in the latter. Again, three-phase transformers are always made with butted joints, and, consequently, any particular coil can be readily replaced without disturbing those on the other limbs; a burn-out that will destroy the winding on all three limbs would certainly equally destroy the three separate transformers. As a matter of fact, the three-phase transformer is superior in nearly every respect, and this is doubtless why the G.E. Co., of America, have recently come into line with European practice, and standardised a complete line of such transformers for power work.

Finally, with regard to high-pressure switchgear, we are surprised to find that Mr. Pearce considers that nothing is standardised in this direction, and that designs are in a transition stage. If an examination be made of the designs brought out by the leading makers during the last few years, not in this country alone, but on the Continent and America, it will be found that the same principle runs through them all when high pressure work of an important character is concerned. It is the principle of "remote control" with manually or electrically-worked oil switches placed in distant compartments of brick or concrete, and the high pressure fuse finds no place in such designs. As far as this country alone is concerned, the development of high pressure switchgear has been late in comparison, but it is of interest to see how closely the designs of the different makers agree.

The very large switchboards in hand at the present time for the Metropolitan Railway, the District Railway, the Newcastle Co., the Yorkshire Power Co., and, lastly, for Mr. Chamen's new station at Port Dundas, are all very much alike in general design, and agree entirely as far as principles are concerned, although the product of three different makers. In our opinion, it will be a long time before such designs as these are materially altered, at any rate as far as really heavy work is concerned.

BOILER HOUSE ECONOMIES.

One of the papers presented to the Municipal Electrical Association was by Mr. R. S. Downe, the borough electrical engineer of Southport. To begin with, Mr. Downe emphasises the importance of coal economy by stating that in some cases it accounts for half the total cost. He next reproduces a table from a paper by Mr. Giles, which shows the poor load factors of a number of stations. These factors vary between 9·96 and 28·44, but out of a list of 30 stations, only three have a factor above 20 per cent.

Three tramway stations, however, have factors of 29·5, 37·15, and 47·7, showing how much better placed are these latter; but Mr. Giles's table, as it is, is not very helpful, for there are no figures of output, and, therefore, no comparison can be drawn. The author realises that a coal consumption of 10 lbs. and upwards per unit of electricity is an excessive amount, and he thinks that, with bituminous slack, economisers and superheaters, and a 15 per cent. load factor, the coal ought not to exceed 5 lbs. per unit. He rather gives away the whole question of station management, however, when he says, "where the railway rate is high and smoke conditions stringent, Welsh coal is used." Does not this very directly point to the weakness of the engineer, who takes just what boilers it suits the boilermaker to supply, and never questions the wisdom and finality of the crude methods of setting in vogue? Under these circumstances, it can hardly be agreed that the conditions are "carefully studied when the lay out of a plant is decided upon," for this is just what is usually lacking and requires improvement.

Realising that Mr. Stromeyer is right in saying that the radiation loss of a boiler is 5 to 10 per cent., the author advocates the working of boilers at high rates, for they may easily lose more by radiation than they will gain by better efficiency of heating surface when more easily worked. He also advocates paying firemen by some system of premium, and quotes Donkin to the effect that where four good stokers were set in turn to fire the same boiler, there was a total range of 23 per cent. of difference of capacity, and 18 per cent. in economy, or £7 to £8 per week with coal at 10s. per ton.

Stopping leakages in brickwork, draught gauges, and CO_2 recorders, are all advocated.

From the author's diagram of his bonus system, we should say that he has fixed the bonus line wrongly, for his firemen get down to it so rarely and so briefly that their bonus will hardly amount to sufficient to induce special effort. True, he is burning too much coal per unit, but it is clear that he would probably burn less if the bonus were an attainable fact, and not an abstract ideal. Firemen will strive to make a small bonus larger, but will throw up the sponge on such an effort as the diagram involves. If his firemen can read diagrams, they will say he has carefully laid out the bonus line so that it may be unattainable, and the men won't play Tantalus to Mr. Downe's Jove for very long.

On the question of superheat the author is not clear. He speaks of the superheater abstracting 10 per cent. of the heat of flue gases and reducing boiler efficiency by the same amount. This is very ambiguous. From his other remarks on superheat it would appear that he has no system of control to his superheaters, and though he speaks of separately-fired superheaters being preferable under certain conditions, he does not say how his small tubes, or any other tubes, are to stand the temperature of 2,500° or 3,000° F. to which they must be exposed in a separately fired superheater.

He states, however, that with down-take superheaters and only 85° of superheat at the engine he has found 16 per cent. of coal economy to be possible

On the question of mechanical stokers he has very little to say, and that little not altogether favourable, but he does not state, what is probably a fact, that very likely some of the stations of which he has particulars have chain grate stokers with no provision against the employment of an excessive air supply. Very properly he points out that a draught may be produced with less energy than required by a chimney, but he does not say that the chimney energy, if not used, must be saved by some means, or the chimney may as well be continued. It is only when he comes to this point that he ventures a protest against the ordinary method of burning bituminous coals in water-cooled furnaces, and to this subject, which underlies so much of the trouble in central stations, he awards less than half a page.

On the question of auxiliary plant, the electrically-driven pump is advised as economical if carefully sub-divided, the author presumably considering that there is too little range in an electrically-driven pump to admit of steady feeding. Hence the use of more than one pump or "careful subdivision."

On the question of feed heating the author puts his ideas into the form of a question as though he had not the courage of his convictions when speaking of the use of fully heated feed. Indeed, he lays down as a generally accepted fact, that it is useless to heat feed except by waste heat. Of course, let waste heat be used to do what it will, but after that use a separate heater and fire or live steam from the boiler to heat the feed to the point of vaporisation. Let the boiler evaporate water only, and it will give more output at a less fuel cost per unit of work.

But here, as elsewhere, the author writes less positively than his knowledge warrants, or his audience needs The municipal engineer wants facts thrown at him in a somewhat dogmatic manner. Mr. Downe has the belief, but he hesitates to lay his beliefs down as law, and his paper has lost value in consequence. Yet his ideas are sound, and he only needs the courage of his opinions.

What is to be deplored is that engineers in charge of electrical generating stations, who, as the author says, have such easy means of knowing what it costs to produce their output, should be so indifferent to the serious question of fuel economy. He himself gives no information on how to burn bituminous fuel, and says that engineers are still seeking for a way of attaining that end.

It reminds one of Horace Greeley's advice on resuming specie payments, which was "The best method of resuming specie payments is to resume." So the best method of burning bituminous fuel is to burn it, *i.e.*, not to put the coal into a refrigerator and pass the gases over cold tubes, but to allow the coal to burn in an adiabatic furnace, as over and over again explained in these columns.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Bowker's "Management of Tramways."

I thank you very much for your "biassed" review of my book. It was certainly most entertaining; and I should certainly have taken it most seriously if I had not known that in the background there was a certain amount of "malice." It is rather unfortunate that you did not submit it to a competent, "unbiassed" expert, instead of reviewing it yourselves. I was certainly honest enough to acknowledge where I obtained my information, which, I am sorry to say, all "writers" refrain from doing.

You dwell considerably on originality. Now, would you kindly inform me how many "technical" books there are published which are wholly original; in the majority of cases, is not the information obtained from various sources? Take your own paper, for instance; do you not copy dozens of articles from American electrical papers, and also take abstracts from the proceedings of various societies? If your memory is somewhat conveniently vague as regards this, I can give you a list. I can also name a certain

standard work on the "Design of Dynamos" which has very little (if any) original information in it. I can also name a work on "Economic Law," which has gone through 15 editions, which is wholly made up of reports from various sources. You refer to my suggestion *re* "Municipal Tramway Association." I may state that I was very well aware of such an organisation, but there is not one on the lines as I suggest in my work, viz., to organise a "fund" with headquarters, officers, &c., to mutually protect themselves against selfish private monopolies. Is it not a fact that your paper (for the past few weeks) has been advocating "compulsory running powers?" It is also a fact that I have in my book, also through the medium of daily papers and the electrical Press, been advocating "non-compulsory" running powers; the case was submitted to the House of Commons a few days ago, and they voted a majority for "non-compulsory" powers. This proves conclusively that, as regards this question, that my judgement is at least as good as yours. Readers will please notice your lamenting wail of disappointment on the first page of this week's REVIEW *re* this question.

I notice that you do not criticise my "advocating of single-deck cars" the same as you did in your criticism of Mr. Rider's book; it is rather significant that lately several corporations have been inviting tenders for single-deck cars?

You make believe being "paragons" and walking encyclopædias of matters appertaining to tramways; but I may say that personally the REVIEW editors cannot teach me anything as regards this matter. I had private reasons, best known to myself, for inserting Messrs. Hewitt and Rhodes and Mr. Upton's articles. It is difficult to write a book which is "ideal" from everyone's point of view. In conclusion, I may state that a certain high-class technical journal have very favourably reviewed my book, and, in my opinion, they are just as capable of judging as yourselves. In the future, I would consider it a favour if you will give an "honest" opinion, leaving out the "venom" which this hot weather has overstocked you with; or else, kindly not review my books at all.

Wm. R. Bowker.

Bury, *July 9th*, 1904.

[We must pass over the personal attacks contained in our correspondent's amusing letter; it is not for us to sit in judgement upon our own impartiality and competency. Mr. Bowker, however, will doubtless be interested to learn that the review in question was written by the engineer of an important and extensive system of electric tramways, whom we are proud to number amongst our expert contributors.

Mr. Bowker's code of morals is interesting, if peculiar; it is not, however, usually considered that the Sparrow who slew Cock Robin obtained absolution by his bold acknowledgement of the deed. That "all 'writers' refrain" from acknowledging the sources of their information is also new to us.

Authorship and compilation are two very different things; we are styled editors, not authors, and it is part of our duty to report the proceedings of societies. We also publish original articles, which, however, cease to be "original" when republished by self-styled "authors."

The fact that the House of Commons has re-committed the matter of compulsory running powers for further consideration has no bearing whatever upon the merits of the question; nor is there any likelihood that the committee will depart from its previous attitude.

Lastly, we regret our inability to teach Mr. Bowker anything; others seem to have experienced the same difficulty, a difficulty similar to that which is proverbially met with in the manufacture of silk purses out of unsuitable material.—EDS. E.R.]

Chimney Construction.

Permit me to add a few remarks to your last article, "American Chimney Construction," where you have doubted the superiority of the American method of chimney building. It may be sufficient to say that since 1846 we (in senile Europa) have been building all our chimneys without the aid of any exterior scaffolding, unless you regard two small boards, which are used by our bricklayers, as scaffolding.

We have by this method—I mean with the aid of only the two mentioned boards—built some years ago a chimney at the Silver Works, Hoboken, near Antwerp, 408 ft. high, with an interior diameter of 12 ft. at the top. This stack required a time of not quite six weeks for erection, and was built by the Ferbeck system, that is, with perforated bricks, which gives the chimney walls great strength, owing to the fact that the mortar penetrates the holes and forms a kind of homogeneous net going from the bottom to the top.

Not long ago I saw in a journal for the building trade, issued in London, a sketch of a small chimney built in America, by an American firm, in which partially perforated bricks were used; it means, that our "surpassed" system was imitated and praised as a marvel of American ingenuity. As this news came from the country of unlimited possibilities I did not wonder. It even did not affect my good humour, as I had the very same day booked an order for the Habana power station chimney, that is to say, on a soil which non-Americans are forbidden to enter by the holy Monroe, MacKinley, and other Lhassa doctrines, and although we were in competition with a dozen of American "Ahead firms."

Ferbeck Chimney Construction Co.,
RUDOLPH GRUNHUT,
Chief Engineer and Manager.

London, *July 9th*, 1904.

Insulation Tests Prescribed by the Board of Trade.

Reference to the above has been made in your last issue of the REVIEW, July 1st, 1904, and it would appear by Clause 41 of the B. of T. Regulations that a definite and conclusive test has to be required by the undertakers before any consumer's connection can be made. Clause No. 41 reads as follows:—

"The undertakers shall not connect the wires and fittings on a consumer's premises with their mains unless they are reasonably satisfied that the connection would not cause a leakage from those wires and fittings exceeding $\frac{1}{10000}$th part of the maximum supply current to the premises; and where the undertakers decline to make such connection they shall serve upon the consumer a notice stating their reasons for so declining."

It would appear by the foregoing that this is the only basis upon which the undertakers can demand a given insulation resistance test, insomuch as this test has reference to.

C. M. Davis.

Electricity Works, Barrow-in-Furness,
July 7th, 1904.

PARLIAMENTARY.

SUPPLY OF ELECTRICITY BILL.

ON the Committee resuming on July 8th, Lord Wolverton was in the chair.

Mr. LEWIS COWARD, K.C., addressing the Committee on behalf of the L.C.C., said that under the Electric Lighting Act of 1882, it was contemplated that each local authority should have the right of purchasing the company within its area after the lapse of 21 years. In 1888 another Act of Parliament was passed extending the period of purchase from 21 to a maximum of 42 years. In London the practice of the Board of Trade had been hitherto in all orders which had been granted to companies to fix the date of purchase at 42 years from August 26th, 1889, the object of that being to synchronise the dates of purchase in London, and he believed that with one exception only, the whole of the undertakings in London became purchasable in 1931. At that time the purchasing bodies were the Commissioners of Sewers in the City and in the part of London now governed by the L.C.C., the vestries, and district boards. In 1882 considerable discussion took place as to who in London should have the powers of purchase. It was suggested on the one hand that they should be granted to the Metropolitan Board of Works, and on the other hand, the local bodies in London set up a claim to be the purchasing bodies. They pointed out that it was a very responsible position which they held in reference to the maintenance and repair of the streets which were to be broken up, and the views of the local authorities prevailed. At that time there were no fewer than 42 vestries and district boards, and adding the Board of Works and the City Corporation they numbered 44. In 1899, when the Local Government Act was passed, and the vestries and the local bodies became merged, they became reduced to 28, and there were now, including the L.C.C. and the City Corporation, 30 local authorities in London. The parts of London which the L.C.C. lighted were the embankments, the various

bridges, and the tunnels under the Thames. The electric undertakings of London were partly in the hands of companies and partly in the hands of local authorities. Counsel then handed in a table showing the areas of the supply companies in London, and said that seven of these companies supplied in the areas of more than one local authority, and of those two had their generating stations outside their area of supply—the Metropolitan Electric Supply Co. and the Charing Cross and Strand Co.—and those generating stations would not be purchasable by the local authorities in whose areas they exercised their rights of supply. A further complication arose by reason of the fact that there were what was known as "bulk" companies supplying in various parts of London. Of those "bulk" companies, one of them was the Charing Cross and Strand, which had powers to supply in bulk in Poplar, Bethnal Green, and outside London, in West Ham. The next "bulk" company was the Kensington and Knightsbridge Co., whose bulk station was situated in Hammersmith, where neither the joint station nor the companies had any power to supply. There was a further company which only had powers to supply in bulk—the Central Electric Supply Co.—whose station was situated in Marylebone. The present Bill, so far as the London County Council read it, seemed to be based very largely on the report of the Select Committee which was presided over by Lord Cross, when a number of recommendations were made. As representing the L.C.C., he (learned counsel) agreed with a very considerable number of those recommendations; but he did not think—and in this view he was supported by all the local authorities—that there was any justification for exempting what were called "bulk" companies from the purchase terms of the Electric Lighting Acts. He wished it to be understood that his remarks applied to London only, and not to the large bulk companies in different parts of the kingdom. Expression had been given to that opinion in 1898 and in 1901, when there were conferences of the local authorities on the matter. The L.C.C. brought in a Bill in 1902, which was supported by the whole of the local authorities, but it was rejected by Parliament. They again introduced the Bill in 1903, but withdrew it as the result of very lengthy interviews with the Board of Trade, who thought that the matter was one for general legislation, and they promised to bring in a Bill for that purpose. The present Bill was the result of that promise, and they welcomed it as a step in the right direction in many respects, but in some respects they felt that it did not touch the very special difficulties which applied to London. The general principles which underlay the Council's two Bills were these—they felt very strongly that it was quite clear that Parliament, both in 1882 and in 1888, enunciated most clearly the principle that all the local authorities should have the power to purchase, and also the right to supply, and they felt that the fact of these electric undertakings having to some extent altered their character should not be used to the advantage of the companies, and to the disadvantage of the local authorities, and in that way override a principle which Parliament had clearly enunciated both in 1882 and 1888. The companies had established their undertakings with the purchase clause clearly before them, and it was not right that they should now be allowed to come forward and say that their shareholders would be injured by the power being exercised.

Mr. Pelham: The Bill does not propose to exempt from purchase any company which is now purchasable.

Mr. Coward said he admitted that it would be impossible, in a great many instances in London, for the local authorities to purchase a self-contained electric undertaking, but he submitted that the local authorities should not be placed in any worse position by not being able to buy at all. The Metropolitan Electric Supply Co., which had its generating station at Willesden, and outside its area of supply, could not be purchased by the local authorities in whose area the company exercised its powers of supply. Paddington, which was one of the areas, appreciated the position it was likely to be in, and obtained a protective clause in the provisional order of 1890, and in 1898, to the effect that the company should establish and maintain within the area of supply one or more generating stations sufficient for the supply of energy under the order. Paddington, therefore, was in this happy position, that it had got the Metropolitan Co. under terms of having a self-contained area of supply in Paddington, so that when the time of purchase arrived in 1930, despite the fact that the company had a large generating station at Willesden, there was also a self-contained supply within the borough, which was purchasable by the local authority. As to the Central Electric Supply Co., that was solely a company for supplying in bulk. It was started to establish a generating station in Marylebone to supply energy in bulk solely to two distributing companies—the Westminster Electric Supply Co. and the St. James's and Pall Mall Co. All three companies were practically one and the same, and there could be no doubt that the object of obtaining those powers which the company got in 1899 was to evade the provisions of the General Act of 1882 and 1888. He believed that the intention of the Committee who passed the Bill was that the company should be purchasable, and so it was; but, as a matter of fact, nobody could purchase it.

Mr. Pelham: I should like to say that I could not be responsible for a Bill interfering with the private rights of a company.

Mr. Coward said he was not passing any reflection upon any action or any want of action on the part of the Board of Trade, but it was obvious that such a state of affairs should not be allowed to continue, as the object of the present Bill was to cure defects which existed in the Acts.

Mr. Balfour Browne, K.C., next addressed the Committee on behalf of 18 electric lighting companies, in support of the Bill. Dealing with the clause relating to the veto of local authorities, he said there could not be any doubt that the effect of that veto in the past had stood in the way of the development of electric lighting and electric traction. The local bodies had interpreted their right to veto very liberally in their own favour, and in a great many cases it had been made the means of screwing concessions out of the companies. In his opinion, it was monstrous that a local authority should be able to say to a tramway company: "Before we allow you to come into our area, you must pay us so many hundreds of pounds per mile." He ventured to think that the Board of Trade had gone too far in its concessions to the local authorities as regarded power schemes; he much preferred the Bill as it originally stood. Dealing with the question of purchase, he said that the L.C.C. was trying to again tie the hands of the Board of Trade, by insisting on a purchase clause, while the whole object of the Bill was that every case should be considered fully on its merits, first by the Board of Trade, followed by an appeal if necessary. He would like to remind their Lordships that on four separate occasions before four separate committees, the County Council had tried to get special purchase clauses, but had failed. He protested against the suggestion that local authorities should have power to supply in bulk.

Mr. Moon, K.C., said that, on behalf of the Metropolitan Electric Supply Co., he desired to associate himself with the remarks of Mr. Balfour Browne; and especially did he take the strongest possible objection to the insertion of a purchase clause.

Mr. Baggallay, K.C., then addressed the Committee on behalf of the London gas companies, and contended that the general tendency to favour electric lighting companies at the expense of gas companies, was perpetuated in the present Bill.

Lord Robert Cecil, K.C., followed on behalf of the borough councils of Fulham, Hackney, Hampstead, Hammersmith, Islington, Poplar, St. Marylebone, Shoreditch, and Woolwich. He said that the Bill would give the Board of Trade power to sanction provisional orders for large power schemes to supply areas without the consent of the local authorities. That was one of the main objects of the Bill. There were two kinds of power schemes—one for supplying authorised distributors in bulk, and the other supplying direct to the consumer. Both were very objectionable to the borough councils; but his chief opposition was to the latter class of scheme, as it was clear that such a scheme as that would enter into direct competition with his clients. The Bill would authorise the grant of provisional orders to large companies for the supply of power, and he was prepared to prove, by evidence, that the local authorities in London supplied power as well as, and more cheaply, than did any of the companies. That question of the supply of power was really vital to the success of an electrical undertaking, and he submitted that provisional order procedure was singularly ill-adapted to such cases as he had referred to. He also objected to the proposed abolition of the local veto, and contended that no case had been made out to show that the local authorities had used their power harshly or unfairly.

Mr. Pelham said he would try and meet Lord Robert Cecil with regard to the question of power schemes.

Mr. Clease having addressed the Committee very briefly for the Kensington and Knightsbridge Electric Lighting Co. and the Notting Hill Co., the Chairman announced that the Committee found the preamble of the Bill proved, subject to modification of the clauses. The Committee then adjourned.

Portmadoc, Beddgelert and South Snowdon Railway.

On July 7th the above Bill came before Mr. J. W. Lowther's Committee of the House of Commons. The Bill empowers the company to construct new railways and authorises an agreement between the company and the North Wales Narrow Gauge Railway, and provides for the sale or lease of the undertaking of the North Wales Narrow Gauge Railway to the company. It also proposes the construction of a new railway 3 miles in length, to be worked electrically. Mr. Pritt appeared for the promoters.

Mr. W. A. Harper, engineer, briefly stated the objects of the Bill.

Mr. Pritt said the Bill had been considerably altered with regard to the financial provisions since it was first introduced to the House. The railway was authorised in 1891, and the Act also authorised a rather unusual thing, viz., the electric lighting of certain places near Beddgelert. There was another Bill which would follow this—the North Wales Electric Power Bill—under which it was proposed to take over those electrical powers authorised in the Act of 1891. By the Bill as amended they were reviving the old capital powers, and asked for authority to raise £24,000 additional capital.

The preamble of the Bill was found proved.

West Ridings Tramways Bill.

This Bill was on July 7th before a Select Committee of the House of Commons, presided over by Mr. J. W. Lowther.

Mr. Freere appeared for the promoters, and said the Bill authorised the Wakefield and District Light Railway Co. to construct tramways and tramroads in Normanton, Whitwood, Wakefield, Castleford, Pontefract, Featherstone, Knottingley, &c., and to raise £156,000 additional capital. To a large extent the tramways represented tramways which had been authorised by provisional orders to local authorities, but which had never been constructed, and with regard to which the powers had lapsed, and the local authorities had now agreed to these tramways being made by the company. The only matter was with regard to Clauses 66 and 67, to which the Local Government Board had called attention. They were clauses which extended the time during which the tramways should be in the hands of the company without being subject to purchase by the local authorities from 21 to 42 years.

Sir Chandos Leigh: It is what we have allowed over and over again. When a tramway is to be an electrical tramway, it would be absurd to allow only 21 years.

Mr. Frere: Certainly. The other point was with regard to Clause 85, which empowered the company to enter into working agreements. At Leeds they joined the tramways of the Leeds Corporation, and again at Ossett, they joined the tramways now being constructed by the local authority under an order of the Board of Trade. Beyond that, these tramways would again join the tramways which were being authorised by the Bill of this session belonging to the Soothill Nether U.D.C. The object of the clause was to allow the company and any local authority where the tramways might be conveniently worked together, to enter into agreements for the working of them, or to enable the company to lease the tramways to these bodies for a period not exceeding 42 years. The clause was in the form in which it was inserted in the Croydon case of 1902, when it was originally settled, and in the Woolwich case in 1903. The circumstances of this case were peculiarly in favour of giving the power, because under the decision of the House this year the Soothill Nether U.D.C. were prohibited from working the tramways themselves. The Local Government Board had also called attention to the clause which gave the company power to take a supply of energy from a local authority, and suggested that the supply of the local authorities should be subject to the Acts under which those authorities were authorised to supply electricity. That, of course, would mean that a local authority could only supply within its own particular order. If, however, they made an arrangement for a supply from the Wakefield local authority, it would be ridiculous to say that they should only supply the energy for the small portion of tramways in the borough, and it meant that the company would not be able to take power from the local authorities at all.

Mr. Green asked if there was any objection on the part of local authorities, between Wakefield and Dewsbury, for instance, who would not have the chance to supply.

Mr. Frere said they had taken no objection. It would be extremely useful, in the case of a breakdown, to be able to go to a local authority, as it would obviate the erection of duplicate machinery which might never be used.

Mr. Cooper having formally given evidence, the Committee found the preamble of the Bill proved.

Bristol Corporation Bill.

On July 7th the Bill of the Bristol Corporation came before the Chairman of Ways and Means in the House of Commons.

Mr. Browne, who appeared for the Corporation, said the principal object of the Bill was to authorise the extension of the Borough boundaries, and, amongst other things, the Corporation sought to take over the electric lighting order of the rural council of Barton Regis. Bristol was taking a part of the district, while the other part was being divided between two other authorities, so that Barton Regis would cease to exist. The Bristol Corporation were their own electric lighting undertakers, and they proposed to take over the whole of the area scheduled in the Barton Regis order. By the extension of the boundaries the Corporation would, of course, be able to supply electricity in the district taken into the borough, but to avoid duplication of electric lighting powers they should exercise the electric lighting powers contained in the Barton Regis order. The question had formed the subject of a good deal of discussion and consideration by the Board of Trade, but they offered no objection.

Sir C. Leigh: The Board of Trade are satisfied?

Mr. Browne: I do not say they have absolutely expressed approval, but they have made no requirement, and leave the matter with you.

The Committee passed the preamble of the Bill.

North Wales Electric Power Bill.

On July 7th a Select Committee of the House of Commons, presided over by Mr. J. W. Lowther, considered this Bill, which empowers the North Wales Electric Power Co. to construct generating stations and supply electricity in the counties of Carnarvon, Denbigh (exclusive of Wrexham), Anglesey, and part of Flint. It also gives power for the company to take over the powers of the Portmadoc, Beddgelert, and South Snowdon Railway Co.

Sir Chandos Leigh said the only point the Local Government Board called attention to was clause 47, which dealt with the question of the company being empowered to take over the electric lighting orders of local authorities.

Mr. Pritt (who appeared for the promoters) said that the matter was fully argued by Mr. Frere before the Committee, when the Derbyshire and Nottinghamshire and the Leicester and Warwickshire Electric Power Bills were before them. In accordance with the views of the Board of Trade, they had inserted a clause which prohibited them, when taking over the order of a local authority, from charging more for power than the rates laid down in the Power Bill itself.

The Chairman asked if the Board of Trade and the Local Government Board had come to any agreement as to the construction of a clause to be inserted in power Bills relating to the taking over of the orders of local authorities.

Mr. Pritt said he had not heard of it. The clause in the Bill was practically the same as that in the South Wales Bill.

Sir Chandos Leigh called attention to Clause 18, which exempted the company from the veto of Urban District Councils with regard to the erection of overhead wires. The Local Government Board had pointed out that, while companies were exempted from the veto of rural district councils, so far they had not been exempt from the veto of urban district councils.

Mr. Pritt said that, in the case of this company, the areas were very rural. The idea was to supply power to quarries and mines, and it was almost essential that they should have the powers. The Board of Trade could prevent them putting up overhead wires.

The Chairman: In the event of a dispute with the Urban District, you would have to go before the Board of Trade?

Mr. Pritt said that was so. The Local Government Board did not object to the clause, but only called attention to the fact that, in previous cases, the clause was only given in the case of rural councils.

The Chairman asked if it was the intention to carry cables overhead.

Mr. Harper said they would only be small wires, not more than ¼ in.

The Committee ordered the Bill to go to third reading.

Loch Leven Water Power Bill.

This Bill came before a Select Committee of the House of Commons, presided over by Captain Jessel, on July 5th.

Sir Ralph Littler, K.C., opened the case for the promoters. He said that the only remaining petitioner against the Bill was Sir John Stirling-Maxwell. The proposal was to modify the scheme which was sanctioned in 1901 for the utilisation of the waters of Loch Leven in driving machinery for the production of aluminium. It was quite true, as Sir John Stirling-Maxwell stated, that the British Aluminium Co. were interested in the scheme, but it was not true that the position of that company was wholly insufficient to carry out the obligations incurred in the work. There was now a large demand for the metal, and the company was in a perfectly solvent condition. The site was an ideal one for a power scheme, there was no industrial population, land was cheap, and the levels were such as to give a good fall of water. Nothing would be done under the extended powers which could in any way injure the petitioner, who owned deer forests and shooting lands in the district. The promoters were prepared to pay Sir John Stirling-Maxwell £6,500 for the lands proposed to be acquired, or the matter could be submitted to arbitration.

Mr. Moon, K.C., said that Sir J. Stirling-Maxwell withdrew his opposition to the Bill of 1901, on the understanding that the works would be completed in six years.

Sir R. Littler said that the delay in starting the works was really due to the impossibility of raising the capital during the late war.

Mr. John Bormar, the chairman of the Aluminium Co., gave evidence as to the position of that company, and Mr. Meek, an engineer, spoke as to the probable time in which the works would be completed. If the Bill passed, operations would commence next spring.

Sir John Stirling-Maxwell, having given evidence, the chairman suggested that an arrangement between parties might possibly be come to. After some discussion between Counsel, it was found that no such agreement was likely to be arrived at.

The Chairman said that the Committee found the preamble of the Bill proved, subject to the payment to Sir John Stirling-Maxwell of £6,500 on or before March 31st next, and in the case of any damage the matter to be submitted to arbitration.

L.C.C. Tramways.

The Bill promoted in this Session by the London County Council, for the construction of certain lines of tramways in the district of Lewisham and Deptford, and the surrounding neighbourhood, came before a Select Committee of the House of Lords, presided over by Viscount Hampden, on Friday.

The case for the promoters was opened by Mr. Erskine Pollock, K.C., who dealt first with the tramways in Lewisham and Deptford (Nos. 11, 12 and 13. No. 11 included, he said, No. 11A). In opening the case, counsel stated that at the present time there were 115 miles of tramway in London, of which 88 miles were owned by the L.C.C. Tramway No. 11 was a line 2 miles 5 furlongs in length. It would start from Honor Oak Park, near Horniman's Museum, and would then pass through Brockley Rise, Stanstead Road, and Malpas Road, terminating in the Lewisham High Road, with a junction with the next line, No. 12. The line would be a double one throughout the length of the route. Tramway No. 12 was also a double line, 1 mile 3 furlongs in length. It would be the connecting link between Lewisham and New Cross. The line would cost, it was estimated, some £58,000 to construct, but this would be irrespective of street widenings, which would add another £22,500. The cost of the first tramway, No. 11, would be £109,000 for construction, and £104,000 for the street improvements which would be necessitated. The next route, No. 13, was a tramway, 1 mile in length, starting from High Street, Lewisham, and running to Lee, and in this case the cost of construction and of the necessary widenings would be £45,000 and £131,000 respectively. The Council further asked for powers to take up and reconstruct for electric traction an existing line in Rushey Green and Lewisham High Road, which, when completed, would serve to connect up the system from Rushey Green to Lewisham. The reconstruction of this line was estimated to cost some £79,000; it was at present a single line, with crossing places, and the proposal was to make it double line all the way. This would involve street widening which would cost £16,450. Paving outside the tracks was estimated to cost another £9,600. Counsel

stated that the L.C.C. had the necessary sanction from the road authorities, and this portion of the scheme was opposed only by a number of frontagers, some of whose forecourts would be taken.

Mr. Maurice Fitzmaurice, the chief engineer to the London County Council, was then called on technical points. He said that it was proposed to construct the lines on the conduit system. The cost of paving outside the track on Tramway No. 11 would be some £18,000.

Cross-examined by Mr. Lewis Coward, K.C., for the frontagers, he said that it would not be possible to make a physical connection between Tramways Nos. 10 and 11 (No. 10 is in another part of the Bill), because the railway was between them. The greatest gradient was one of 1 in 36, the same as that of the Haymarket. There were four places along the route of No. 11 where the distance between the outer rail and the kerb was less than the statutory width of 9 ft. 6 in.

Re-examined: Witness said that there was nothing to interfere with the electrical working of a tramway on a gradient of 1 in 36. Where possible they always allowed the statutory width of 9 ft. 6 in. between the rail and the kerb. It was of importance where the thoroughfare was one with houses and shops, and there was a liklihood of carts, &c., stopping in front of premises, but where, as in one case in the present scheme, the place at which the width was less than that allowed by law, was where the line passed over a river, it was not so important.

Mr. Allan Baker, the chairman of the Tramways Committee of the L.C.C., also gave evidence. A number of local witnesses having been called in support of this part of the Bill,

Mr. Fell, the tramways manager to the Council, gave evidence. He considered that the proposed lines were a necessary extension of the existing L.C.C. tramway system. There would probably be a very heavy traffic on Tramways Nos. 12 and 13. On No. 11 the traffic would be fairly heavy. It always took some time to educate people to use a line. He estimated the receipts from No. 11 at £10,539, and the working expenditure at first at between £6,000 and £7,000. Nos. 12 and 13 he took together and estimated the receipts at £16,000, and the expenses at between £8,000 and £9,000. He anticipated a large increase as time went on. There had already been a large increase in receipts on the south side of the river since the electrification, and it was his experience that the electrification of tramways always tended to increase the number of passengers carried. There was nothing difficult in the working of the lines.

Mr. Hayward, the Comptroller to the Council, was then called to speak as to an alleged deficiency in the receipts of the L.C.C. tramways. He explained that there had been a deficiency of £8,283 on the south side of the river, and it was accounted for in this way: The profit on the electric trams had been £78,877, and the profit on the remaining horse trams £15,575, making a total of £94,453. The interest and sinking fund charges on the new electric traction debt and the old horse traction debt was £100,536, and income-tax brought the total up to £102,736, so leaving the deficiency of £8,000. Had it not been for these charges, the profits would have been enough to have paid a 5 per cent. dividend, if they had been those of a private company. The northern system had to be taken into account, however, and these lines, leased to the North Metropolitan Co., yielded a surplus profit of £27,657, so that on the whole the profit on the Council tramways was £18,C00.—The Committee adjourned.

On Monday Mr. Lewis Coward, K.C., addressed the Committee on behalf of the frontagers who opposed the scheme. Counsel based his argument against the tramways on their great cost, which, he said, averaged over £40,000 per mile. The cost was due to the proposed adoption of the conduit system, which was four times as expensive as the overhead system. A number of frontagers were called to speak in opposition to the various routes, and,

Mr. Moon, K.C., addressed the Committee in reply for the L.C.C. He said that where a tramway was proposed there was sure to be a numbers of frontagers who would rather not have the tramway. It mattered not whether the promoters were the L.C.C. or the London United Tramways Co. While respecting the motives of those people, he felt sure that they had not taken into account the value and necessity of the lines to other people. The voice of the people in the road through which a tramway would run was not the voice of the people served by that tramway.

The Chairman, at this point, intimated that the Committee desired the learned counsel to confine his address to the question of finance.

Mr. Moon, continuing, said that the London County Council never imagined that the Bill would be attacked on finance, as little had been said on that head when the Bill was before the Commons; in fact, finance had really only been glanced at there. Their Lordships would realise that if, as had been alleged, there was a deficiency on the working of the trams, it would not fall on the persons residing in the district in which the deficiency took place, but would fall on the whole of London. But, he contended, there would be no deficiency. They had heard about a deficiency on the South London system. It was true there had been a deficiency, but it was due to the fact that the tramways were in a state of disorganization owing to the work of electrification. In one or two cases the lines yielded only two months' traffic to the receipts of the Council's financial year. During reconstruction there was always an amount of dead capital, and the Council had to pay interest on this as well as the sinking fund, although the capital had not become fruitful. Further, the Council were incurring an expenditure in respect of having to purchase current for their trams, their generating station at Greenwich not being completed. Since the electrification of the tramways the receipts had increased enormously, and this was the common experience. In many towns, Glasgow, he believed, was one, the whole population was in the course of one year carried 100 times over. The London County Council had been pressed to construct the proposed tramways for some years past, and whether the proposed routes would pay immediately on opening was not the question. If a local authority said, "We require a tramway to enable the people to go further afield," he thought it was evidence that the tramway was desirable. And in this case the local authorities were willing to pay one-third of the cost of the improvements. In conclusion, counsel referred again to the sinking fund. An ordinary company, having no sinking fund, made their depreciation account a sort of sinking fund. In the case of the L.C.C. it was not necessary to have a depreciation account, as they carried an amount forward to a renewal fund.

The room was then cleared. On the re-admission of the parties the Chairman announced that so far as Tramways Nos. 11, 12, 13, and 13A were concerned, the Committee found the preamble proved.

Mr. Erskine Pollock, K.C., then dealt with the next portion of the scheme (Tramway No. 4). The proposal was to construct a tramway from Grove Vale, commencing with a junction with a tramway authorised in 1902, but not yet constructed, skirting Peckham Rye Common, and terminating at the South-east end of Peckham Rye. There were three short routes in connection with the line. The estimated cost of construction of the lines was £42,050, and the conduit system would be adopted. The cost of paving works outside the rails would be an additional £1,500, making a total of £43,550. Tramway No. 10 was a line from Grove Vale to Forest Hill. The line would cost £72,600 to construct, and the widenings necessary would take another £21,500. This line was opposed by the London, Camberwell, and Dulwich Tramway Co., who own a line, now disused, in the Lordship Lane. The Committee adjourned.

On Tuesday a number of witnesses were called in support of Tramway No. 4.

Mr. Maurice Fitzmaurice, the engineer to the Council, said that the cost of the line would be £42,050, while paving would cost £1,500.

Witnesses were called also with regard to Tramway No. 10, against which a petition had been lodged by the London, Camberwell, and Dulwich Tramway Co., who own a deserted line in part of Lordship Lane.

Mr. C. W. Tagg, the town clerk of Camberwell, was called, and said that the Borough Council, who were the road authority for the route of No. 4 and the greater part of No. 10, was unanimously in favour of the scheme, and had requested the L.C.C. to make the proposed extensions.

Evidence having been given in opposition,

Mr. Pollock announced that, as the result of a conference between representatives of the parties, the London County Council had undertaken to purchase the whole undertaking of the London, Camberwell, and Dulwich Co. for £6,500.

After conferring, the Committee passed Tramways Nos. 4 and 10. Formal evidence was given in support of the remainder of the Bill, and clauses were adjusted.

Bournemouth Corporation Tramways Bill.—This Bill came before the Chairman of Ways and Means as an unopposed measure on July 7th. Mr. Pritchard, for the Corporation, stated that the main object was to authorise the construction of a tramway in substitution for a present authorised line. Last session, the Corporation of Bournemouth obtained an Act under which they were to acquire the undertaking of the Poole Electric Traction Co., and that undertaking had power to construct tramways extending from Bournemouth to Christchurch. The route for the tramway was not satisfactory to the Corporation and they were by the Bill proposing an alternative route. Further, the tramway would cross a bridge over the Stour, which was a toll bridge, and the Corporation were proposing to purchase this. Mr. Bailey, Town Clerk, gave formal evidence and the Bill was ordered to go for third reading.

Holywood Tramways Bill.—Mr. J. W. Lowther's Committee of the House of Commons had this Bill before them on July 7th. The Bill incorporates a company with a capital of £54,000 to construct about 5½ miles of tramway in Belfast and Down. There was no opposition, and the preamble was declared proved.

London United Tramways Bill.—On July 7th this Bill came as an unopposed measure before the House of Lords Committee, presided over by Lord Balfour of Burleigh, and was ordered to go for third reading.

Electricity in Mines.—In reply to a question by Mr. Markham last week, Mr. Akers-Douglas declined to take steps to appoint electrical inspectors to enforce the new electrical rules, though if necessary he would consider the possibility of providing the inspectors with expert advice. Mr. Markham further suggested that the recommendations of the Electricity in Mines Departmental Committee were opposed to the latest practice, but Mr. Akers-Douglas dissented from this view.

LEGAL.

Hartley *v.* Chadwick.

This case came before a Divisional Court composed of the Lord Chief Justice and Justices Kennedy and Phillimore, on 7th inst., on a special case stated by the Justices of Leigh, Lancashire. It appeared that on March 29th, 1903, an information was preferred

before the Justices alleging that on March 11th, 1903, respondent unlawfully and wilfully stopped a lorry which he was driving, in such a manner as to obstruct a tramcar on the South Lancashire tram line. It was either proved or admitted before the Justices that the respondent was in the employ of a firm of brewers of Leigh, and that at about 4.45 p.m. of March 11th appellant was driving a tramcar from Leigh to Lowton, and respondent was driving a lorry from Lowton to Leigh. They met at a point on the incline of a bridge on the L. & N.W. Railway. The lorry was on its proper side of the road, but there was not room to pass the car on that side, and the driver refused to cross to the wrong side to allow the car to pass. It appeared also that the car driver could have stopped at a loop where there was a double line, but he did not do so, and was ultimately compelled to back the tramcar to the loop, as the dray driver refused to get out of the way. The appellant submitted that it was a case of obstruction on the part of the respondent, and that if the respondent had adopted the reasonable course of crossing to the other side of the road no obstruction would have taken place; they urged that there was no law as to a right or wrong driving side, that the tramways had been sanctioned by Parliament, and that drivers using the highway over which tramcars run should not unnecessarily and wilfully interfere with the free running of the tramcars.

Mr. Danckwerts, K.C., and Mr. Blair appeared for the appellant, and Mr. Horridge, K.C., and Mr. Cunningham Glen for the respondents.

For the respondent, it was submitted that he was not acting in any wrong way in maintaining his right to drive on his own side of the road, and that he was under no obligation to cross to the wrong side for the convenience of the appellants, who must have seen him before the tramcar left the loop, and it was the duty of the appellant to stay on the loop till respondent's dray had passed.

The Justices were of opinion that the onus lay upon the appellant of proving that a change of the law relating to the user of the highway by the public had been effected by the passing of the Tramways Act,' and he had failed to do so. They were also of opinion that the respondent had not acted unlawfully in maintaining his right to drive on his left or customary driving side, and consequently there had been no wilful obstruction, and they dismissed the information. In the result, their Lordships said that both parties ought to act reasonably in the matter, and, with that direction, they remitted the case to the Justices for rehearing.

Metropolitan Electric Supply Co., Ltd., v. London County Council.

In the Chancery Division of the High Court of Justice, on Friday, Mr. Justice Kekewich had before him an action by the Metropolitan Electric Supply Co., Ltd., claiming a declaration that upon the true construction of Section 55 of the London County Council Improvements Act, 1899, the defendants were bound within three years from the passing of the Act to acquire the freehold and all other interests in the whole of the new site therein specified since events which had happened to convey to the plaintiffs the freeholds of the whole of the new site, also to pay to the plaintiffs the sum ascertained under certain sections of the Act. The plaintiffs further asked that such other orders might be made as would provide for the carrying out of the obligations imposed on the defendants under Section 55 of the Act.

Mr. Cripps, K.C., who appeared with Mr. P. Ogden Lawrence, K.C., and Mr. Sargeant, for the plaintiffs, said there were three matters involved in the case, which arose partly under a section of the Act of Parliament, and partly on arbitration between the parties. Two of these points, concerning the period when the conveyance to the reinstated site should be made, and concerning interest, he thought, could be settled without troubling his Lordship, but on the third point the opinion of the Court would have to be taken. In connection with the new site, the Supply Co. had been given a road which was not the road they were entitled to under the Act. Plaintiffs said they were entitled to access in a straight line along Little Wild Street into the new street known as Kingsway. Defendants, on the other hand, were giving them access to the new street by a circuitous route. The Act provided that the defendants must maintain a public street not less than 25 ft. in width along the northern boundary of the property leading into the new central street. The street which had been given by the County Council was not in direct connection with the new street, but was a street which ran along the northern boundary into another street, which other street led in turn into a third street, which third street led into the new central street.

Mr. Stewart Smith, K.C., who appeared with Mr. Meltiold for the defendants, submitted that the Act gave the County Council liberty within reasonable limits to make a connection between the street bordering the proposed new site on the north and Kingsway, and did not force them to do it in any particular method.

His Lordship said his difficulty was to give the words "leading into the new central street" any other construction than leading directly into the new central street.

Mr. Stewart Smith submitted that there was no deviation, except where it was necessary to bring the continuation of Little Wild Street into such a position that it joined with the continuation from Wild Court, and thereby made one entrance into Kingsway instead of two. The actual deviation was only 50 ft.

His Lordship said Little Wild Street extended the whole length of the northern boundary of the property, but the street to be given was not only a street along the northern boundary, but a street leading directly into the new central street. He thought the meaning of the section was that the street should be leading direct into the new central street. The street proposed to be given was not one which seemed to him to comply with the terms of the Act, and he thought the Council would not fulfil their obligations if they gave such a street. He made a declaration accordingly.

Mr. Cripps intimated afterwards that it had been arranged that the mutual conveyances as between the parties in order to carry out the exchange of the sites should be completed within a month from that date. The question as to interest was also arranged.

Is a Tramway System a Railroad?

In the Glasgow Sheriff Court an important judgement was pronounced last week involving the question as to whether a tramway car system is a railroad. The action was brought under the Workmen's Compensation Act. The widow and children of Alex. Franklin sued the Glasgow Corporation Tramways for compensation for his death. The deceased was a lineman, and met his death while in the defenders' employment on April 15th last.

The Sheriff finds that when the accident happened deceased was engaged in engineering on a railroad, and awards £280 compensation.

In a note to his judgement the Sheriff said: The facts were not in dispute. The only contested question was whether deceased, on the day he met his death, was in the statutory sense engaged in engineering work upon a railroad. The definition of "engineering work" in Section 7 (2) of the Act included repair work. He thought that a man engaged in repair work on any part of the permanent way of a traction system was engaged in repair of a "railroad." That an electric car system was a railroad there could be no doubt, but it was agreed in the statutory sense it was not a "railroad," because the word "railroad" in the fifth definition of Section 7 (2) was synonymous with the word "railway," in the first definition, which word railway had a limited signification. In his Lordship's opinion, this argument was not sound. He thought "railroad" in the fifth definition was a word of wider scope than the word "railway" in the first definition. If electric tramways had been meant to be included in the term "railway," then tramways would have been specifically mentioned—just as light railways were mentioned—in definition one. But tramways were not mentioned, and the Regulation of Railways Act of 1873 did not apply to the electric tramway system in question. This first definition was not, in his opinion, applicable to this case. The only definition applicable was the fifth, and that covered the present claim.

[The judgement has been appealed against by the defenders to the Court of Session, in order that an authoritative judgement may be obtained on the point.]

Damages for an Electric Shock.

At Dudley County Court, before Judge Howland Roberts and a jury, the wife of Mr. M. J. Law, fitter, brought an action against the British Electric Traction Co. to recover £50 damages for injuries sustained. Plaintiff stated that on May 16th she travelled from Brierley Hill on an electric car, and when descending from the top deck, she laid hold of the brass stay in the middle of the step, placed there to assist passengers in boarding and alighting, and experienced an electric shock which caused her to fall into the road. It was contended that it was impossible for plaintiff to experience a shock in the manner described. The jury gave a verdict for the plaintiff, awarding her £10, after the Judge had summed up most strongly in favour of the defendants, and we understand that a new trial is to be applied for.

BUSINESS NOTES.

Annual Outings.—In beautiful weather last Saturday the employés of Messrs. H. T. Boothroyd, Hyslop & Co., mechanical and electrical engineers, Bootle, held their fifth annual picnic and sports at Chester. The party, numbering about 60, left Liverpool early in the morning, arriving at Chester in good time; the morning was spent by the majority boating on the beautiful River Dee. The dinner was served in excellent style at the King's Head Hotel, Chester. Mr. Garrick proposed the toast of "The Firm," this being seconded by Mr. Tetlow. In the afternoon the whole party proceeded by the river steamer to Eccleston, where a most enjoyable time was spent, during which the annual sports were held. A substantial tea was provided after the sports at Partington's Cafe.

The employés of the London Electrical Fittings Co., Ltd., held their seventh annual outing the other day at Arundel. At the dinner Mr. F. Denning, who presided, in proposing "The Continued Success of the Firm," reviewed the work of the past year, and stated that, in spite of the general depression in trade, the firm were doing remarkably well, and the output generally increasing; especially was this the case with regard to the class of work embodying old English styles, to which the firm had been lately giving so much attention.

Water-power Plant for Textile Mill.—We are informed that Messrs. James Gordon & Co., of 52, Lime Street, E.C., have secured the contract for the supply and erection of one of their improved vertical shaft "Samson" turbines to develop 150 H.P., together with all shafting, gearing, &c., for a textile mill in the North of Ireland, where it will be used for driving a new electric power plant which they are installing.

"Eburin."—We are informed by Messrs. A. & E. Cohen, with respect to our remarks on "Eburin" last week, that its specific gravity is not 2·68, but from 1·6 to 1·9, so that it is not much denser than ebonite. The material, when moulded, is ready for use without further polishing or other manipulation, while the tensile strength can be varied, depending upon the relative proportions of the ingredients employed, the strength of ebonite having been greatly exceeded when desired.

North Wales Electric Power and Traction Co.—The 10,000-H.P. hydraulic station is now well under way, and 18 miles of new railway line are in course of construction. The pipe line and dam works are in full swing, and it is expected that current will be available by the end of the year. A considerable portion of the 10,000 H.P. to form the first installation has been already booked. The contract includes the supply of six 1,000-KW. 10,000-volt turbo-alternators, 10 250-H.P. locomotives, the whole of the rolling stock for the new line, the complete erection of the hydraulic works, transformer stations, and over 100 miles of high-tension transmission lines. The whole of this work is being carried out by the sole contractors, Messrs. Bruce Peebles & Co., Ltd.

Electrical Ore Finding.—It is reported that the experiments recently carried out on Wetherlam Heights, Coniston, have resulted in the successful localisation of four lodes of copper, and the discovery that a known lode ended in a narrow stringer. The last item was proved by sinking a shaft, and the other determinations will also be verified by actual trial. Further experiments are to be carried out upon iron ore deposits in the Furness district.

Bankruptcy Proceedings.—Under the failure of Henry Binko, electrical engineer, 34, Leadenhall Street, E.C., and 4, Highbury Crescent, N., the first meeting of creditors was held on Thursday at the London Bankruptcy Court before Mr. C. A. Pope, assistant receiver. The debtor has stated that he originally commenced business as an engineer and patentee 35 years ago with a free capital of £2,000. He has traded for nearly 20 years as H. Binko and Co., with the exception of an interval of three years, when the style was Binko, Ridsdale, & Co., Ltd. During these three years he and a partner, George Gibson, formed their business into a limited company, and held the bulk of the shares. The company was voluntarily wound up. He (debtor) has also been a director of the Patent Speaking Tube Co., and more recently of the Electric Heating Corporation Ltd., whose office was in his office. He has financed those companies, whose affairs are rather mixed up with his own. A previous failure in the London Court is recorded against the debtor 35 years ago. He attributes his present failure to the financing and guaranteeing of the two above-mentioned companies. The Patent Speaking Tube Co. are now taking proceedings against the Commercial Union Assurance Office for breach of contract in failing to guarantee £35,000 debentures in the company. As a director and chief shareholder in the former company the debtor is interested in these proceedings, which will shortly be tried, and he looks to the result of the trial to enable him to pay all his debts in full. The statement of affairs shows total liabilities £4,914 1s. 5d., and assets valued sufficient to discharge all the debts and leave a margin of £9,008 2s. 10d. The assets consist almost entirely of the debtor's interest in the Patent Speaking Tube Co., Ltd. Acting upon a request of the creditors, the meeting was adjourned for three weeks to await the result of the litigation with the Commercial Union Assurance Office, before appointing a trustee and committee of inspection.

The report of Mr. G. S. Barnes, senior Official Receiver, upon the affairs of the Automatic Telephone Co. (1903), Ltd., has been issued to the creditors and shareholders. The report states that the plant and machinery were erected by Mr. Margowski at Greenwich, and on the winding-up order being made, Mrs. Margowski claimed to be in possession of the machinery under a mortgage. The unsecured debts only amount to £275, and a surplus of £3,899 in assets over liabilities is shown, but the account with the contributories discloses a deficiency of £10,051. The Official Receiver observes that there are matters connected with the company which require further investigation, and he will probably apply to the Court for an order for a public examination.

Catalogues and Lists.—MESSRS. JOHN ABBOT & CO., LTD., send us a copy of their catalogue of electric cranes, winches, capstans, &c.; they are devoting special attention to this line, and have exceptional facilities for quick delivery. The catalogue includes fixed pedestal and portable jib cranes, overhead travellers, and self-contained capstans.

A new circular has been issued by the METALLIC SEAMLESS TUBE CO., LTD., of Birmingham, particularising their patent "Grip" conduit system, which it is claimed meets the demand which has arisen for a system which gives a perfect metallic connection, electrical continuity, and efficient earthing, and possesses many advantages over the ordinary socketed or screwed conduits. The company are also large manufacturers of conduits and accessories of other kinds.

MESSRS. B. WEAVER & CO., of 22, Rosoman Street, E.C., send us illustrated sheets and price lists of their standard "Ebonestos" insulating switch-handles, bushes and nipples, which are always to be had direct from stock. Judging from samples received, the material is well adapted for plain and screwed nipples and bushes, the thread being well formed, and the dimensions in strict accordance with the drawings. The metal parts are also well finished, with full threads to Whitworth and B.A. gauges.

We have received a list of books on ventilation, especially the "natural" system advocated by the late Mr. Robert Boyle and his son, from MESSRS. R. BOYLE & SON, 64, Holborn Viaduct, E.C.

The IMPERIAL LIGHTING CO., of 13, Gate Street, W.C., send us a sheet of illustrations showing their "Fairyland" system of electrical illuminations, with which remarkable decorative effects can be obtained. The material for this purpose is let out on hire at a very small charge, or can be supplied to purchasers. The firm has recently supplied 300 8-C.P. lamps on this system to a seaside resort, and has booked 2,500 lamps for Swansea on account of the King's visit.

The CRYPTO ELECTRICAL CO., of Bermondsey, is issuing a new circular of the Crypto alternate current motor.

We have received MESSRS. FRANZ MEGUIN & CO.'s new catalogue of perforated metals and dynamo stampings, giving illustrations of a great variety of standard sizes and patterns of the former, and samples of dynamo and transformer stampings, which are supplied to any desired pattern. A table is given showing the equivalent values of the British, German and zinc gauges in decimals of an inch and in mm., with the corresponding weights per sq. ft. Mr. ANDREW BROWN, of 110, Cannon Street, E.C., is sole agent for the company in the United Kingdom.

MESSRS. MARSH, SON & CO., LTD., of 15, Gerrard Street, W., send us an advanced copy of their latest catalogue, which is much more complete than previous issues, and covers almost all kinds of electrical accessories. Amongst so many items it is difficult to pick out one thing rather than another for notice; everything required for an installation of electric lighting, telephones, bells, fire alarms, fans, &c., appears to be listed and provided with a code word. A large section is devoted to electric light fittings and shades of the most varied patterns. The volume, which is of considerable size and weight, will prove valuable, not only as a catalogue and price list, but also as a reference book.

"Electricity for Power Purposes" is a handsome work issued by the BRITISH POWER CO., LTD., of 5, Great George Street, S.W., full of excellent illustrations of the application of electrical power to many different industrial operations, artistically arranged and produced. Special attention is given to colliery working, hauling, pumping, machine-tool driving, cranes, and other heavy engineering purposes, but minor applications are not overlooked. There is but little letterpress, and what there is relates to the many advantages of electricity for motive-power, and to the facilities offered by the company for the supply of motors, either by purchase outright, or by hire-purchase over a period of five years. A "Motor Inquiry Form" is enclosed with the volume.

We have received a price list of the GERMANIA ELECTRIC LAMP CO.'s standard and special incandescent lamps from their agent, Mr. G. S. Wilson (see "Trade Announcements").

MESSRS. ERNEST F. MOY, LTD., of Greenland Place, Camden Town, N.W., send us leaflets showing their D.P. 2-way knife switches, type No. 102, with dimensions and prices for capacities from 50 to 1,000 amperes. The contacts are mounted on separate enamelled slate bases, divided by fibre fillets, and insulated from one another with ebonite bushes.

We have received from the IMPROVED ELECTRIC GLOW LAMP CO., LTD., of 7, Great Newport Street, W.C., their new list of electric fans for direct and alternating currents, for desk, bracket, ceiling, port hole, and other modes of fixing. A novelty is their "Electric Thermantidote," consisting of a 12-in. fan, which draws air through a screen of netting kept moist with water, thus cooling the air, and, if desired, charging it with perfume or disinfectant. Small motors, dynamos, &c., are also listed.

MR. ED. BRAND, of 35, Shakespeare Street, Manchester, has issued a leaflet drawing attention to his automatic wire and sheet straightening and cutting machinery, riveting machine, &c.

Book Notices.—"Ready Reference Tables, Vol. I.—Conversion Factors of Every Unit or Measure in Use." By Carl Hering. New York: John Wiley & Sons; London: Chapman and Hall. 10s. 6d. net.

"Sammlung Electrotechnischer Vorträge," Vol. VI., parts 3 and 4. Stuttgart: Ferdinand Enke. M. 1·2 each.

"Corso di Elettrotecnica." Vol. I.: Alternatori, dinamo a corrente continua e trasformatori. By Guido Grassi. Torino-Roma: Casa Editrice Nazionale. L·14

"Universal Directory of Railway Officials, 1904." By S. R. Blundstone. London: The Directory Publishing Co., 10s.

"An Enquiry into, and an Explanation of, Decimal Coinage and the Metric System of Weights and Measures." By Edwyn Anthony, M.A. London: Geo. Routledge & Sons.

"The Design and Construction of Oil Engines." By A. H. Goldingham. London: E. & F. N. Spon; New York: Spon and Chamberlain. 6s. 6d. net.

"Propriétés et Essais des Matériaux de l'Electrotechnique." By F. de Poncharra; and "Enroulements d'induits à Courant Continu." By E.-J. Brunswick and M. Aliamet. Paris: Gauthier-Villars. Fr. 2.50 and Fr. 3 each.

"Gas Works Directory and Statistics, 1904." London: Hazell, Watson & Viney. 10s. 6d. net.

Reduction of Capital.—Notice is given in the *London Gazette* of the 8th inst., of the registration of an order of the High Court of Justice, confirming the reduction of the capital of the British Aluminium Co., Ltd. and Red., from £400,000 to £310,000.

Transvaal Imports.—The value of the imports of electric cables, wire, and fittings into the Transvaal during the three months ending with March last, is returned at £19,000, as compared with £15,000 in the corresponding quarter of 1903.

Dissolutions and Liquidations.—The Electric Extension Co., Ltd., has passed resolutions for the voluntary winding-up of the company, Mr. C. E. Ruckley being appointed liquidator.

Municipal Finance.—At the monthly meeting of the Liverpool City Council last week, Mr. Harmood Banner, chairman of the Finance Committee, moved that £100,000 be lent at 4 per cent. to the Sunderland Corporation, and a similar amount at the same rate of interest to Tynemouth. The money proposed to be lent was part of the sinking fund set aside against the corporate debt. The sum set aside per annum is £278,608, equivalent to 2·6 per cent. of the total debt, which stands at £13,525,607. If no fresh debt were incurred, the sinking fund would wipe off the debt in 50 years. The Corporation loans out the sinking fund because there are no willing sellers of 3½ per cent. and 2½ per cent. stock. The motion was agreed to, and the Council decided to apply to the L.G.B. for sanction to borrow £400,000 for the extension of the electricity works. Perhaps Manchester or Birmingham will be induced to lend its sinking fund to Liverpool for this purpose, and so on—a process akin to taking in each other's washing for a living.

Damages for Electrical Injuries.—At Manchester Assizes last Monday, an iron turner, named Thomas Kay, was awarded £850 damages against his employers, the British Westinghouse Co., for injuries sustained at their Trafford Works. Hurrying along with a crowd of fellow-workmen to leave the premises, plaintiff fell or was pushed against an electric lighting switch of high voltage, which burned away one eye and the flesh of his cheek. The switch, it was alleged, ought to have been fenced.

Raworth's Traction Patents.—The Railway Commissioners of the Government of New South Wales have decided to make a trial of the automatic regenerative system of control. The work will be carried out under the supervision of Mr. Oswald Haes.

Trade Announcements.—Mr. Andrew Brown, of 110, Cannon Street, E.C., has been appointed agent for the London district for Messrs. G. B. Smith & Co.

Mr. G. S. Wilson, of Sandown, Cambrian Road, Richmond Hill, Surrey, has taken up the sole agency for the American Sun Lamp, manufactured by the Germania Electric Lamp Co., of New Jersey, U.S.A.

Messrs. S. Dixon & Son, Ltd., of Leeds Old Brass Works, have opened an office at 22, Walbrook, E.C., under the direction of Mr. Morris Dixon.

Exhibition at Burton-on-Trent.—An electrical exhibition was opened at Burton on Tuesday last, and will remain open until to-morrow night. The exhibition is one of the most extensive of the kind that has been held in the Midlands, some 30 firms being represented, and a special feature is the large number and variety of single-phase motors driving machines of different kinds, particularly those adapted to local requirements.

In connection with the exhibition, an illustrated pamphlet has been issued by Mr. P. J. Pringle, borough electrical engineer and tramways manager, entitled "Commercial Applications of Electricity," in which, while lighting, heating, &c., receive due treatment, special attention is given to the use of electricity as a motive power. A table of powers required to drive various classes of machinery is given, and the way is made clear for any person to adopt electric driving without difficulty. Altogether Burton is showing itself fully alive to the possibilities of electricity supply, and is right up to date in enterprise.

Sales.—The stock of the British Schuckert Electric Co., Ltd., whose business has been transferred to Messrs. Siemens Bros. and Co., Ltd., is to be sold by the liquidator, Mr. A. Jacob. See "Official Notices" to-day.

The modern engineering works of Hemingways, Ltd. (in liquidation), situated near Middlesbrough, are to be sold by public auction as a going concern at the North-Eastern Hotel, Darlington, on 26th inst., at 3 p.m., by Messrs. Wheatley Kirk, Price & Co., of 46, Watling Street, E.C.

The Ironmongery, Hardware and Electrical Exhibition.—The fifth annual exhibition of these, and the allied trades, was opened on 12th inst. at the Royal Agricultural Hall, Islington. The number of exhibitors representing the electrical industry is not so large as might be desired, but those firms who have taken space exhibit many interesting appliances, &c., for small power users and domestic purposes. Among those in the electrical trade, Messrs. Tulley & Straker, of 16, Water Lane, E.C., show their patent folding mica fire screens of various designs, mica washers, &c.; Messrs. F. A. Glover & Co., Ltd., Garrick Street, W.C., display electric motors, their patent "plano-convex" fans, oscillating and desk fans, switchboard, instruments, and a small direct-coupled Glover-Robey generating set; the American Electrical Novelty and Manufacturing Co., Ltd., 102, Charing Cross Road, W.C., exhibit hand and pocket electric lamps, bells, dry batteries, art metal fittings, and electric clocks, the latter of an improved type without springs; the Electrical Accessories Supply Co., Southampton Row, W.C., art fittings, small accumulators, a new silvered glass reflector shade, hand lamps, &c.; the Lister Electrical Manufacturing Co., their semi-enclosed electro-motors; the British Prometheus Co., Ltd., of Kingston-on-Thames, electric kettles and flat-irons, and electric heating apparatus of all kinds. Many fine art metal fittings were also shown by Messrs. Potter, Williams & Co., 4, New Zealand Avenue, E.C., agents for the Société Anonyme pour la Fab. d'Appareils d'Eclairage. The exhibition closes on July 22nd.

LIGHTING AND POWER NOTES.

Aldrington.—The Brighton Corporation has come to terms with the Hove Corporation, after prolonged negotiations, with regard to supplying energy in bulk to the above parish. The trunk mains from the Southwick generating station will be laid through Hove, thus saving a long detour.

Bangor.—The T.C. has consented to the electrical engineer, Mr. Price White, acting as consulting electrical engineer to Carnarvon T.C. in connection with the E.L. scheme, on condition that the recent increase of £40 per annum in his salary is postponed until April, 1905.

Bangor (Co. Down).—The U.D.C. is about to apply for an order to erect an electricity works in the town for street lighting.

Belgium.—La Société d'Electricité du Bassin de Charleroi reports a profit of only £876 for the past financial year.

Bodmin.—The T.C. has received from the Southern District Electricity Corporation notice of its intention to apply for a prov. order for electric lighting, and the Council has asked the company for particulars. The Council has asked the B. of T. to defer consideration of the revocation of the E.L. order for six months to enable it to make arrangements for providing E.L. in the town.

Cannock.—The U.D.C. has entered into negotiations with Messrs. Whittaker Bros., of Dudley, for lighting the district by electricity, and the works are to be erected near the centre of the town.

Chorley.—Notice is given in the *London Gazette* of 8th inst. of the intended transfer of the Chorley E.L. prov. order to a company, the latter paying £384 to the Corporation to defray the costs of obtaining the order.

Claremont (Western Australia).—This Municipality, situated on the Swan River, midway between Perth and Fremantle, recently raised a loan of £7,000 for E.L. purposes. Acting on the recommendation of the consulting engineer, Mr. H. Rowley, M.I.E.E., the Council has signed an agreement with Messrs. J. Parre Johnston & Co., of Perth, for the supply and erection on site of two 76-H.P. B. & W. boilers with superheaters, two 50-KW. E.C.C.-Willans steam dynamos, together with balancers, switchboard, mains, &c. The distribution will be by overhead mains on the three-wire continuous-current system at a pressure of 460 volts between the outers. It is proposed to charge consumers 7d. per unit.

County Armagh.—The Urban and Town Councils of Armagh and Portadown are inquiring into the cost of an E.L. scheme for their respective towns in connection with the provisions of the Ulster Electric Lighting and Power Bill.

Cuckfield.—Notice has been received by the U.D.C. of the intention of the Hayward's Heath Electric Supply Co. to apply for a prov. order to supply energy within the Council's area, and also within the district of the R.D.C.

Dudley.—The report on the year's working of the electricity undertaking shows that the annual output has been increased by 470,000 units. The income was £10,662, and the working expenses £5,650. The gross profit was £5,012, of which £4,357 was paid in principal and interest on loans, leaving a net profit of £655; the total net profit for the past two years was £1,451.

France.—La Société Lyonnaise des Forces Motrices du Rhone, of Lyons, reports a profit of £45,840 for the last financial year, as compared with £52,148 in the preceding 12 months.

Glasgow.—In connection with the extension of the University buildings, which is at present being carried out, electric power is being introduced for the purpose of driving a large mortar mill and an electrical derrick crane. The crane has been supplied by Messrs. Butters Bros., Glasgow.

Hastings.—On July 6th a L.G.B. inquiry was held into the application of the T.C. for a loan of £3,416 for E.L. purposes. There was no opposition.

Hereford.—The L.G.B. has sanctioned a loan of £1,100 for the completion of the E.L. installation at Burghill Asylum.

Herne Bay.—Messrs. Down & Johnson have informed the U.D.C. that they intend applying, on behalf of the Electric Supply Corporation, for a prov. order for E.L. in the district.

Horwich.—The U.D.C. has consented to the Bolton T.C. supplying energy to certain parts of the town until the Council is in a position to provide the supply itself.

Irvine.—The T.C. has decided to put into effect the powers granted under its E.L. prov. order, 1903, and has placed the work in the hands of Messrs. Kirkland & Capper, of Victoria Street, S.W., who drew up the scheme for the burgh. The cost of the scheme is estimated at £10,000.

Italy.—Application has been made for a concession to put down a plant to utilise the power of the River Antona at Massa for generating electrical energy to run a marble-cutting works at that place.

King's Norton and Northfield.—The U.D.C. has rescinded the resolution passed on February 28th, 1902, to the effect that no public money should be spent in carrying out the E.L. order, and has decided to obtain expert advice on the offers received for the working of the order, and to take such steps as may be deemed expedient to avoid the revocation of the order, which has only one more month to run.

Kingsbridge.—The U.D.C. has decided not to object to the application of the Kingsbridge and Salcombe and the Southern Counties Electrical Cos. for a prov. order for electric lighting.

Leeds.—The City Council has decided to apply to the L.G.B. for sanction to borrow £100,000 for electric lighting purposes.

London.—Fulham.—The borough electrical engineer recently pointed out the necessity of immediately making provision for the coming winter's load. The E.L. Committee, after careful consideration, instructed the electrical engineer to prepare a comprehensive scheme dealing with probable future requirements for the next five years, which would be carried out from time to time as necessity required. The reports and plans now submitted give particulars of a scheme which, he is of opinion, will be found necessary. The total estimated cost of the same is £129,000, viz.:—First section, £42,000; second section, £32,000; third section, £25,000; mains, sub-stations, &c., £10,000; house connections, meters, &c., £20,000. The first section, which he recommends, should be authorised at once, comprises the following: engine room plant—one 750-kw. turbo-alternator (already ordered), £7,000; one 1,000-kw. Belliss set complete with condensers, pumps, &c., £8,947; one exciter set, £500; switchboard additions, £500; boiler house—four boilers with accessories, £4,340; coal bunkers, elevators, &c., £2,230; economisers, £1,075; boiler pumps, £250; wiring motors, &c., £200; condenser steam and other pipes, £3,000; condenser sump and river work, £2,000; chimney, £4,000; boiler house buildings and alterations, £7,500; contingencies, £500; for connections, £6,000; extra buildings, £4,000; total, £52,042; less already sanctioned by the Council, £7,000; total to be sanctioned by the Council, £45,042. The £4,000 for extra buildings is recommended in order that the boiler house may be constructed to its full extent, with a view to future economy. The Committee recommends that the first extension in the scheme should be sanctioned.

City.—The Charing Cross and Strand Electricity Supply Corporation, Ltd., has issued a circular calling attention to a clause in some of the City of London Co.'s forms of contract, which appears to extend the agreement for a fresh term of three years whenever an addition is made to any of a customer's installations. The Charing Cross Co. states that no such clause has ever been embodied in any of its own agreements.

L.C.C.—On 12th inst. the Council resolved to lend £20,000 to the Poplar B.C. for the extension of the E.L. undertaking, and £9,958 to the Shoreditch B.C. for similar works.

The Council has approved plans submitted by the Marylebone B.C. for the erection of a generating station on a site abutting on Richmond Street and Salisbury Street.

Poplar.—The B.C. Electricity Committee on 13th inst. provisionally accepted the offer of a freehold site in Eliza Place, Wick Lane, for the proposed northern sub-station. The price is £1,400. The accounts of the undertaking show a credit balance of £4,474, which it is considered should be carried to a reserve account.

Hackney.—The Electricity and Works Committees have approved the replacement of 66 gas lamps in three roads, now giving an equivalent of 1,852 c.p., by 30 arc lamps giving an equivalent to 14,100 c.p. The cost of maintenance will it is estimated be £271 per annum as against the present cost of £203 for gas. The lamps it is proposed to install are to be of 7 amperes, and the estimated capital expenditure for the alteration is £2,031.

Littlehampton.—The U.D.C. has had under consideration a proposal to obtain, without expense to the Council, a prov. order for E.L., and to supply energy at 5d. per unit for lighting, and 3d. for power. The Council favours the proposal, but has asked for the option of purchase at the end of 14 instead of 21 years.

Liverpool.—The City Council, on the recommendation of its Electric Power and Lighting Committee, has resolved to apply to the L.G.B. for sanction to the borrowing of a further sum of £400,000. £76,000 of the amount is to be expended as follows: £5,300 for extensions of sub-stations, £8,000 for sub-stations connected with the Lister Drive stations, £3,500 for meters, and £59,000 for underground mains. The recommendation was adopted after some discussion.

Manchester.—The work of the electricity department and the present position of the undertaking were considered by the City Council at its meeting last week. The increased demand for energy during the last two years has been very considerable. Two years ago the amount generated was 10 million units; in the year just closed it reached 29 millions. This has resulted from the working of the completed tramway system. The chairman (Mr. Howarth) explained why the profits of the undertaking were not so large as the increased demand for electric energy would seem to warrant. The work was begun, in a small way, some 10 or 12 years ago, and the demand at first was such that they were led to believe that in the course of a year or two it would be almost unlimited. They in consequence laid down a plant of 40 million units capacity. The sinking fund and interest, provided for during the past 12 months, amounted to £106,000. That would not matter if the whole of the plant were productive. But some three years ago, the Committee, with the Council's sanction, made a very large extension at Stuart Street at a cost of about a quarter of a million sterling. They knew now from the experience of the past winter, that the plant at the two other stations was ample, without the Stuart Street extension, for all requirements. The Stuart Street extension had been carried out a few years too soon. The loss in sinking fund and interest amounted to something like £20,000 a year, which had to be met out of revenue. In spite of this the balance sheet was better than had been expected. Whilst the price of energy had been reduced, it was able to show a balance on the right side; and a sum of £25,000 had been set aside for renewals and suspense account, and £6,000 had been added to the reserve, bringing this up to £32,000. It would be useless to expect better results until the unproductive capital could be brought into use. The best is being done to extend the use of electricity, and there are at the present time three or four proposals under consideration for large supplies, which, if carried through, will help materially. In the course of discussion, suggestions were made for a further reduction in the price of energy in order to bring the new plant into use. The Committee, however, could not pledge themselves on that point. The report was approved.

Matlock.—Messrs. Foote & Milne, of London, have informed the U.D.C. that they intend applying to the B. of T. for a prov. order for the electric lighting of the town.

Naval Establishments.—Electric lighting is to be installed at Haslar Hospital, the work having already been begun. The generating station is to be placed in the gunboat-yard. It is expected that the electric light will also be introduced in the Royal Clarence Victualling Yard, as well as at the Royal Marine Light Infantry Barracks at Forton.

Nelson.—The L.G.B. has granted the application of the Corporation for sanction to the borrowing of £25,000 for E.L. purposes.

Newport (Mon.).—The Corporation Electricity and Tramways Committee has decided to adopt a scheme submitted by the borough electrical engineer for extensions to the existing plant. An additional 300-kw. set is to be installed, together with a battery, thus enabling the Highfield boosting plant to be used, this will increase the capacity of the lighting plant by 500 kw. The estimated cost of these additions is £f,000. It was also recommended that new H.T. feeders be laid in certain districts, and that two new sub-stations should be constructed, at a cost of about £1,900, and that additional L.T. feeders be laid and a balancer fixed at Llanarth Street sub-station. This is estimated to cost £4,725. It was decided to make application to the Local Government Board for sanction to borrow £17,825 to cover the cost of the above, and to allow for future mains extensions. Some recent tests with arc lighting having proved satisfactory, it was decided to extend the system, and, as far as possible, fix the lamps to the tramway standards throughout the town. Other departments of the Corporation are to be charged by the Electricity Department on the same scale as ordinary consumers.

Oulton.—The U.D.C. has decided to take expert advice with respect to entering into an agreement with the Oulton Broad Electricity Co. regarding the application for a prov. order.

Penge.—The U.D.C. has decided to abandon its proposal to apply for a discharge of the agreement originally made with the Lewisham Electric Light Co. to supply light for a portion of the district. The Blackheath and Greenwich District Electric Light Co. has informed the Council that it intends laying mains throughout the whole of the district for the supply of energy, and this has been approved.

Perth.—The Electricity Committee has accepted the offer of Messrs. Davidson & Co., of Belfast, for an induced draught fan at £425.

The T.C. has agreed to reduce the price of energy to small consumers by ½d. per unit.

Prestwich.—The Salford T.C. has fixed the price of energy for power purposes at 2d. per unit for the first 1,000 units, and 1½d. per unit beyond.

Rochdale.—On the 7th inst., owing to a workman driving an iron stake between the flags on the causeway and through one of the E.L. cables, and causing it to fuse, the electricity supply to the whole of the town was suspended for a short time, and in one locality for the whole night. An explosion also occurred in one of the feeder boxes, being indirectly caused by the fire.

Rye.—The Mutual Electricity Supply Co. has informed the T.C. that it intends to apply for a prov. order for electric lighting, but at a recent meeting it was stated that it was not likely that the Council would let the power to supply energy go out of its own hands.

Shoreham (Sussex).—The Hove Electricity Co. has informed the U.D.C. that it intends to apply for a prov. order to supply energy in the district. A special Committee has been formed to consider the matter.

Southport.—The electrical engineer, Mr. R. S. Downe, estimates that during the next three years it will be necessary to expend £20,000 for the purpose of extensions to the electricity works, mains, machinery, &c. The Electricity Committee has resolved to make application to the L.G.B. for sanction to borrow this sum. The sum of £800 is to be expended in laying a new main to the flying machine which is being erected on the front.

South Wales.—Last week-end a party of visitors inspected some of the works of the South Wales Electrical Power Distribution Co., by invitation of the latter. Leaving London for Cardiff on Friday, the party on Saturday visited the Pentyrch sub-station, a colliery at Wattstown employing 800 H.P. of electrical power from the company, and the Pontypridd power station, which contains plant of 3,930 KW. The mains are already 40 miles in length, and by the end of next year there will be 26,000 H.P. connected.

Southwick.—The U.D.C. has received from the Hove Electricity Co. notification of its intention to apply for a prov. order for electric lighting within the Council's area. It is suggested that the Council should obtain its own order.

Sydney (N.S.W.).—The E.L. Committee has considered a report dealing with the appointment and salaries of the official staff, numbering 48 hands. The salaries proposed for the first year of working are:—City electrical engineer, £700 per annum; chief assistant engineer, £400; first senior assistant engineer, £200; second senior assistant engineer, £175; two junior assistant engineers, £150 each; four engine drivers, £156 each; four switchboard attendants, £93 12s. each; two stokers, £130 each; one stoker, £124 16.; three engine-room improvers, £93 12s. each; three trimmers, £109 4s. each; one senior sub-station attendant, £169; one senior sub-station attendant, £156; four sub-station attendants, £124 16s. each; one mains foreman, £156; one meter electrician, £156; two meter readers, £109 4s. each; one foreman lamp trimmer, £156; five lamp trimmers, £93 12s. each; one lamp lighter, £109 4s.; shorthand writer and typist, £78; storekeeper, £110; five apprentices, £20 each; one labourer, £109 4s.; making a total of £6,151 12s. per annum. The recommendations were adopted, excepting that relating to the city electrical engineer, certain proposals having to be further considered with respect to this appointment.

Turton.—The Lancashire Electric Lighting Co. is applying for a prov. order to supply electrical energy in the district.

West Ham.—The electrical engineer has reported the financial result of supplying energy to the municipal artizans' dwellings. 282 tenements are connected, and the average price per unit obtained was 4·37d. The total revenue from this source during the past 12 months was £246, and the expenditure for lamp renewals, wages, &c., £97, leaving £149 available to meet capital charges, generating costs, &c. The units consumed were 13,522, which, at the cost price at 2·74d. per unit, came to £154; a loss to the electricity undertaking of £5. It was resolved to continue the supply. Complaints as to the emission of black smoke from the generating station were discussed, and it was resolved to adopt a mechanical under-feed stoker, at a cost of £370, in place of a Babcock chain grate stoker. It was also reported that as an outcome of a circular letter addressed to a number of manufacturers in the borough respecting a power supply, a draft agreement had been come to with the directors of the Thames Ironworks, under which the company agrees to take a minimum of 250,000 units per annum increasing to a maximum of 500,000. The estimated cost of laying the necessary cable was £488. This has been approved, and the expenditure sanctioned.

Whitstable.—The Southern District Electricity Corporation has decided to apply for an E.L. prov. order to supply electricity in the town.

Willesden.—On 11th inst. at a special meeting of the U.D.C. held to consider the report of a special committee regarding the management of the electricity undertaking, it was stated that in January last a letter was received from the North Metropolitan Electric Power Supply Co., inquiring whether arrangements could be made whereby its electrical engineer, Mr. Murray, should continue in charge of the power station, the company agreeing to pay a proportion of the engineer's remuneration. The Council agreed that the electrical engineer should take temporary charge of the station as requested. On May 26th the company proposed that Mr. Murray be appointed to the Power Co., and that he should be at liberty to advise the Council in a consultative capacity for the term during which the Power Co. has made itself responsible for any deficiency which the Council may have in working. The U.D.C. has agreed in the event of the company appointing Mr. Murray as its electrical engineer to fall in with the suggestion that he should act in a consultative capacity for the U.D.C. at a salary of £300 per annum, the appointment to be for three years.

Wolverhampton.—The result of the past year's working, ended March 31st last, shows a gross profit of £11,495, equal to 8·3 per cent. on the capital expenditure. Out of this the amount allowed for interest is £3,839, and sinking fund, £4,881, leaving a net profit for the year of £2,775. The Committee is of opinion that this result is very satisfactory in all respects. A reduction was made in the price of energy for lighting purposes during the period covered, and a reduction was also made in the charges for public street lighting, the actual reduction in revenue from this cause being over £1,400. The Committee reports that the expenditure on generation and distribution, inclusive of all management charges, was less for the past year's working than for the preceding twelve months, although the output of electricity increased by over 21 per cent. During the year the output of electrical energy to private consumers for motive power increased by 55 per cent. The number of consumers connected amount to 739 against 655 last year; the number of 32-watt lamps connected amount to 64,382, against 54,578. The number of units sold amounts to:—Public lighting, 96,264; private lighting, 1,099,172; traction, 776,358. The maximum load recorded was 1,295 KW. The greater proportion of the capital expenditure has been, it is stated, in respect of mains. The Committee has decided that mains shall be extended in all directions where there is any prospect of adequate revenue being obtained, although the expenditure so incurred may not be remunerative for the next two or three years. The mains are to be extended in Waterloo Road, from Whitmore Hill to Christ Church, at an estimated cost of £750.

TRAMWAY AND RAILWAY NOTES.

Aberdeen.—At a meeting of the T.C. the accounts for the year's working of the tramways which were submitted showed an increase in receipts, as compared with last year, of £12,936. The working expenses showed an increase over last year of £11,425.

Ayr.—An inquiry under the Private Legislation Procedure (Scotland) Bill has been held in Glasgow into the application by the Corporation for a provisional order in connection with the extension of its tramways. Powers were asked to double a section of line. At present they could only give a 10-minutes' service, but if the line were doubled, they would be able to give a service every five minutes. This portion of the line was at present worked by a system of signals, which gave rise to frequent delays. There was also the question of running 'buses beyond the tramway limits, and they asked two extensions in this respect. In addition to a sum of £7,000 already paid under the depreciation and reserve fund, they asked authority to borrow £25,000 for extensions and other expenses, and £10,000 as working capital. After hearing favourable evidence, the Commissioners found the preamble proved, with certain modifications in the proposed double track. Authority to run the 'buses was refused, and the financial clauses were modified accordingly.

Berlin.—A serious dispute has arisen between the Great Berlin Tramway Co. and the municipal authorities in regard to the projected tunnel extension of the underground and elevated electric railway from the Potsdam Place to the inner part of the city, and first of all to the Spittelmarkt. The company claims that the City Council has no right to authorise the extension, but that in case the work is proceeded with, it is entitled to compensation, on the ground of diversion of traffic from the electric tramways. With a view to testing the question, the Council instituted proceedings against the company, and the Court of First Instance has decided in favour of the former. The Court holds that the company has no right to object to the prolongation of the railway, and that it is not justified in raising a claim against the town for damages on account of the ultimate opening of the extension to traffic. The company now intends to take the case to the High Court.

Blackburn.—As a heavily laden electric car was running uphill from Blackburn to Darwen on Saturday evening, through some failure in the electrical apparatus the woodwork of the car caught fire. There was a panic among the passengers, several ladies' skirts becoming ignited, and one man who leaped from the top of the car sprained his wrist and cut his head badly. The fire was quickly extinguished with sand.

Black Country.—On the invitation of the British Electric Traction Co., a conference of representatives of interested local authorities was held in Birmingham last week, respecting the stoppage of the tramways since June 15th between Dudley and Wednesbury, and Wednesbury and Darlaston, and the reconstruction of the lines for electrical equipment. On behalf of the local authorities, it was pointed out that the action of the company in ceasing to run the old steam trams had caused serious inconvenience to the travelling public; that, until some arrangement had been made as to the reconstruction of the lines, the company should allow the steam cars to continue running; that the company had undertaken by an agreement with the Tipton District Council to electrify the line in that parish by the end of April last; and that, pending the removal of all the difficulties in connection with the reconstruction of the whole of the two routes, the company should at least electrify the line from Dudley to Prince's End, a twopenny stage. In regard to the stoppage of the tramway between Dudley and Wednesbury, it was explained on behalf of the company that the service had been unprofitable, and that they could not incur additional loss by a continuance of steam traction. With respect to the electrification of the lines, the company's engineers stated that, due to subsidences, some portions of the road would have to be raised as much as 3 ft. A continuance of such subsidences would seriously damage the tramway. They also stated that it was quite impracticable to electrify the line in sections. The chief obstacle to a settlement was the Corporations of Wednesbury and Dudley in reference to their powers of purchase, and the matter would probably involve arbitration. Mr. Garcke was the chief representative of the tramway company, and the conference ended without any definite result.

Southend-on-Sea.—The B. of T. has recently confirmed the undermentioned order made by the Light Railway Commissioners:—Southend-on-Sea and District Light Railways (Extensions) Order, 1904, authorising the construction of light railways in the county of Essex, in the borough of Southend-on-Sea and the urban district of Shoeburyness.

(*Continued on page* 103.)

THE NEEPSEND POWER STATION OF THE SHEFFIELD ELECTRICITY DEPARTMENT.

The casual visitor to Sheffield has probably always associated its name with the production of steel, and more particularly of cutlery. His near approach to the city, with its vista of chimneys and smoke, reminds him more forcibly than words of the relative importance of Sheffield among the great industrial centres of the earth.

Few of our readers will be disinclined to allow that in such a city, electricity with its modern applications to metallurgical, chemical, and manufacturing processes, must play an important *rôle*, which, we venture to think, will not suffer anything from the hygienic possibilities which it offers in this case.

Mr. S. E. Fedden, A.M.I.C.E., M.I.M.E., General Manager and Engineer.

Many of the large works in the neighbourhood are already well equipped with more or less independent electrical plants, but there must always remain an enormous field for a general supply authority, and in this case the Corporation, who undertake the function through their electric supply department, have laid themselves out to meet a continually increasing demand for electrical energy.

Sheffield's acquaintance with electric lighting is by no means modern, it being recorded that the Bramhall Lane ground, of football fame, was illuminated by arc lamps as far back as the year 1878 by Mr. John Tasker. The same gentleman later commenced a public supply from his factory in Sheaf Street, and this formed the nucleus of the Sheffield Electric Light and Power Co., which was formed in 1892 with the object of supplying a portion of the city, for which Parliamentary powers had been obtained.

The progress of this undertaking rendered necessary the building of a generating station and offices, the former at Sheaf Street, and the latter at Commercial Street, where, on January 1st, 1898, both were taken over by the Corporation as the result of negotiations during the previous 12 months.

The plant at Sheaf Street now consists of eight marine boilers by Messrs. J. Brown & Co., Ltd., and five water-tube boilers by Messrs. Babcock & Wilcox, Ltd. The whole of these boilers (and, in addition, those in the new power station) are arranged for induced draught, steam-driven fans being employed to draw the air, which has previously been heated by passing through tubes round which the discharging furnace gases circulate, through the fires. The draught is further augmented by small steam jets in the open ends of the fire bars. These boilers are rated to evaporate 130,000 lbs. of water per hour, the steam pressure being 160 lbs. per sq. in.

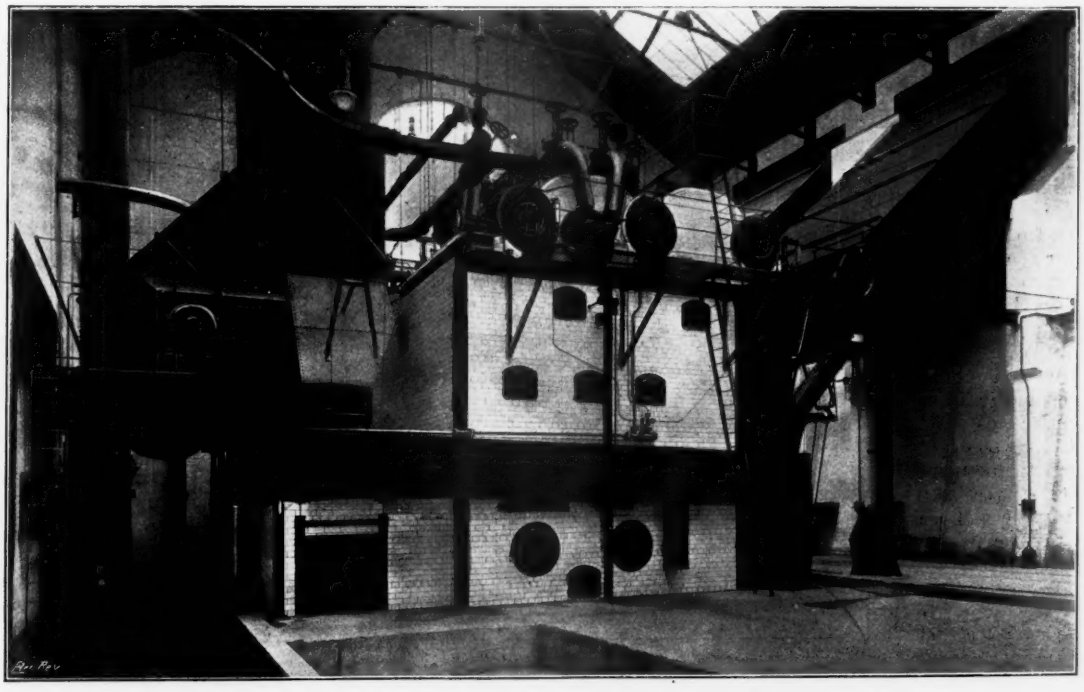


Fig. 1.—View of Boilers, Induced Draught Plant, and Coal Shoots.

The engine room at Sheaf Street must be at once the joy of the engineering historian, and the sorrow of the station

superintendent, yet withal a place of more than ordinary interest. Here are installed two 500-KW. turbo-alternators by Messrs. Parsons, in process of conversion from single to two-phase winding, and which originally upheld the honour of the British section at the Paris Exhibition of 1900.

Amongst the reciprocating plant are a compound and three triple-expansion marine type engines of McLaren's well-known make, coupled respectively to a 600-KW. Ferranti, and 550 and 300-KW. E.C.C. alternators, a 900-KW. compound condensing steam alternator by Messrs. Ferranti, Ltd., a 700-KW. compound condensing steam alternator of Browett, Lindley-Brush parentage, and last, though not least, in point of interest, a set, which after a more or less serious explosion some years ago, struck work and now enjoys a well-earned rest.

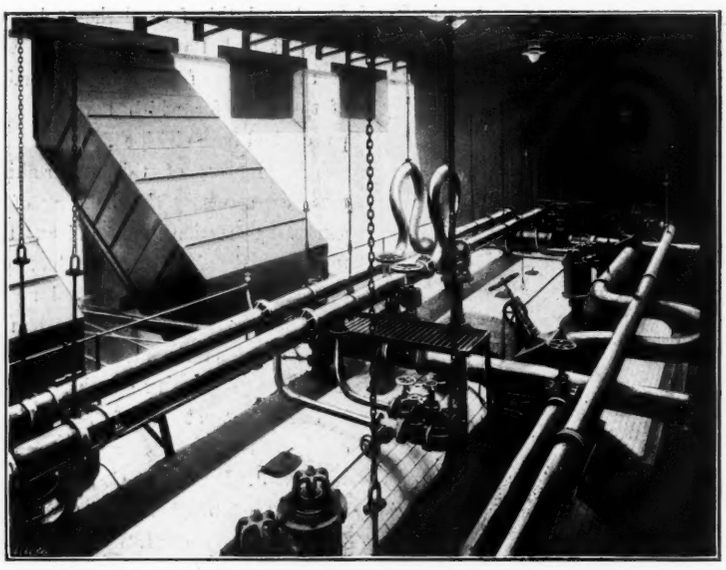


FIG. 2.—VIEW OF PIPEWORK OVER THE BOILERS, AND COAL SHOOT.

The total capacity of working plant here, amounts to 4,400 KW. Both jet and surface condensing plant is used, the water being obtained from a reservoir near the works in conjunction with a fan draught cooling tower.

Now, although the Sheaf Street plant is perhaps scarcely arranged in accordance with modern ideas, yet there can be no doubt but that the accumulated experience here gained has been of the greatest value to Mr. Fedden, the chief engineer, in connection with the comprehensive scheme of power supply, which his corporation has adopted, and which has entailed the construction of a new power station on a less restricted site some two miles from the centre of the city.

The locality selected for the new generating plant was at Neepsend, where an area of 10 acres situated on the hill side, between the Great Central Railway and the River Don, had been secured.

The buildings at present erected are arranged to accommodate some 6,000 KW. of plant; the space would, however, probably admit of this amount being quadrupled.

Owing to the nature of the site, the arrangement adopted was to cut away a portion of the hill side below the railway, and secure the latter by means of a substantial retaining wall.

Below and parallel with the retaining wall were constructed boiler and engine houses, the former 109 ft. long × 70 ft. wide, and the latter 124 ft. long × 70 ft. wide with a height of some 63 ft. from floor to roof.

Both buildings are exceedingly light and airy, the engine house walls being lined throughout with white glass tiles, and the mosaic flooring provided with numerous floor lights for illuminating the basement.

The contractors for the buildings, &c., were Messrs. Wellerman Bros., Hyde, and for the constructional steel work, Messrs. the Pendleton Iron Works Co., Pendleton. The excavation necessitated some 40,000 tons of earth being removed, a considerable portion, however, being converted into bricks for use in the buildings and retaining wall, at the Corporation's brickworks on the site.

Above the retaining wall and adjacent to the boiler house, was erected a coal store, capable of holding some 1,000 tons, and filled from two railway tracks in connection with a siding from the Great Central Railway.

At the entrance to the siding is situated a weighbridge, capable of weighing either the ordinary or bogie type of coal truck, and in addition to the coal siding a track is provided under a travelling crane situated over a recess in the retaining wall, and worked by hand power.

This crane is capable of manipulating loads of 20 tons, which can be taken from the railway and lowered on to a tramway in the yard connecting with the engine and boiler houses, thus providing an efficient means of dealing with heavy plant in case of extensions or repairs.

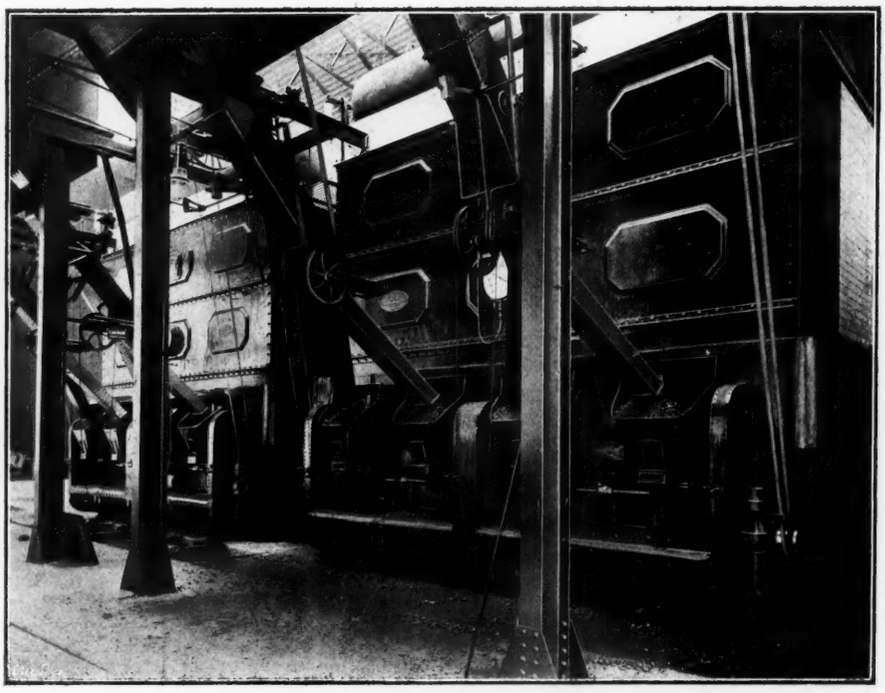


FIG. 3.—VIEW OF BOILER FRONTS, STOKERS, COAL MEASURING APPARATUS, &C.

From the coal store, the coal falls by gravity into inclined steel shoots ending in breeches pipes over the stoker hoppers,

An ingenious measuring apparatus is provided above the breeches pipe, by means of which the amount of coal passing is automatically registered on counters. The valves are so arranged that it is impossible for the attendant to obtain coal without due registration, as the indicator must register before the coal valve is opened, and conversely the outlet valve must be closed before the feed valve is opened.

The collection of ashes is carried out by means of small dumping cars running in a tunnel below the firing plates, the ashes being deposited in the hopper of the ash elevator situated outside the end wall of the boiler house, and ultimately lifted into a storage bin from which carts or trucks can be loaded.

The elevator is constructed with overlapping buckets, with a view to protecting the steel chain, and is driven by a 7-B.H.P. two-phase motor fitted with speed reducing gear.

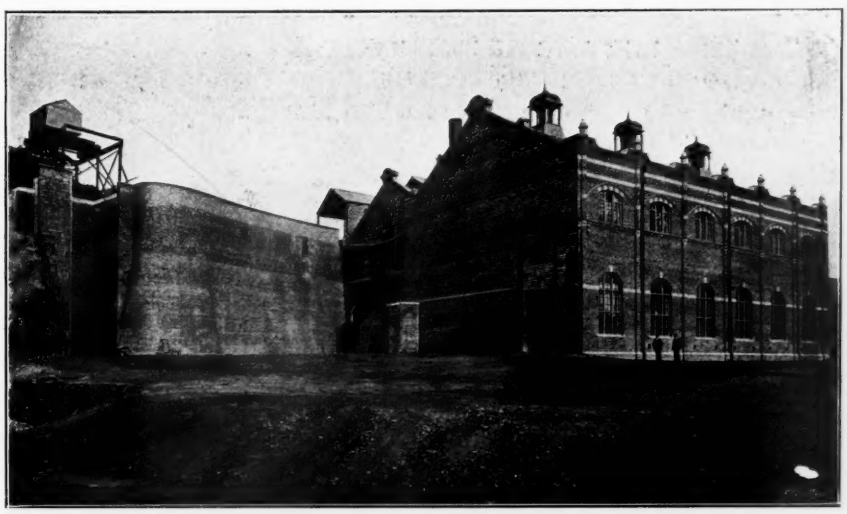


Fig. 4.—Outside View of Station, showing Crane for Handling Plant in Connection with the Railways.

The contractors for the steel work in connection with the coal shoots and the ash handling plant were Messrs. E. Newell & Co., Ltd., of Gainsborough.

Coming to the boilers, of which four of the Stirling type have been ordered and two installed, they are of the Standard five-drum type and rated to evaporate 30,000 lbs. of water per hour each at a working pressure of 200 lbs. per sq. in.

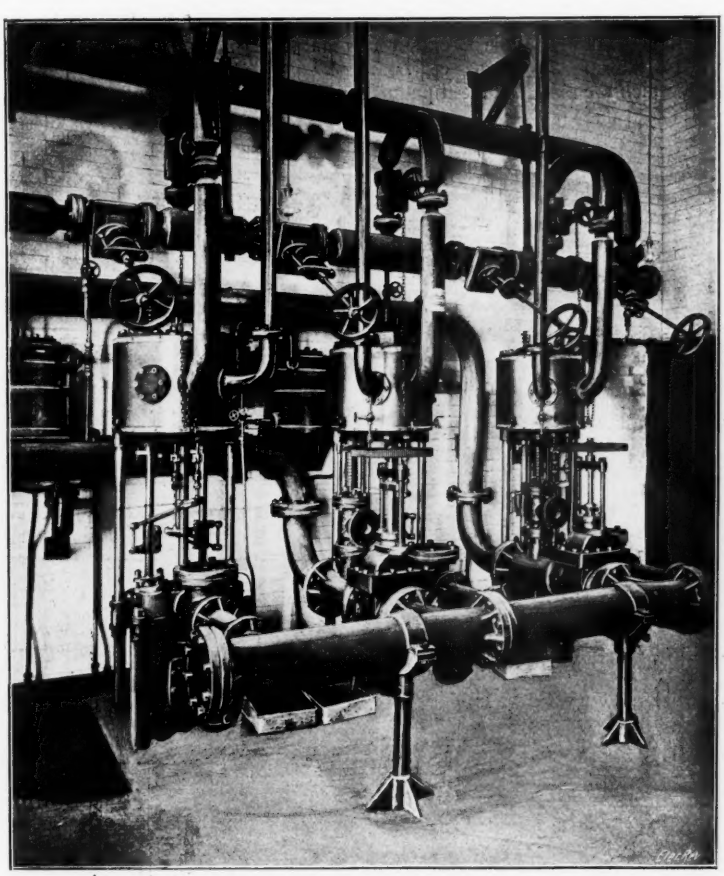


Fig. 5.—Worthington Double-Acting Feed Pumps.

Each boiler is fitted with three steam drums, 3 ft. 6 in. diameter, and two mud drums, 3 ft. in diameter, connected by four nests of solid-drawn weldless steel tubes, 3¼ in. outside diameter, arranged on the well-known Stirling principle.

In this boiler the feed water enters the back steam drum, and as only steam tube connections are provided with the central drum, it of necessity circulates through the back or cooler portion of the boiler before entering the active front sections—an arrangement which facilitates the early settlement of any deposit in the rear mud drum and tubes, where it would be unlikely to cause trouble through overheating.

Each boiler has a heating surface of 6,210 sq. ft. and 80 sq. ft. of grate area, some 80 per cent. efficiency being guaranteed by the makers.

The National Boiler and General Insurance Co. have supervised the construction of all the boiler plant.

The boilers are fitted with Bennis's patent quadruple machine stokers and compressed air furnaces, each grate consisting of cast-iron side bars, and seven compressed air bars fitted with grids, the backs of the furnaces being sealed with brickwork carried on a cast-iron frame.

The stoker and furnace mechanism carried on the furnace front is adapted to the induced regenerative air system employed; it provides for the motion of the furnace bars and of the mechanical stokers.

The stokers consist essentially of pneumatic throwing-out boxes, which are arranged to give a wide variation in fuel feed. They are driven from two 3½-B.H.P. two-phase electric motors per boiler, through counter-shafting by means of raw hide belts, and arranged in two sections, so that either motor may on emergency work both sections. The furnaces are also adapted for hand firing if necessary.

Of special interest are the arrangements provided for forcing these furnaces. Opposite each compressed air box a $\frac{1}{16}$-in. diameter steam jet is provided, the steam being superheated by passing through a copper coil arranged in the ashpit, and regulation effected by means of a valve on each jet pipe.

In addition to the above, each boiler is provided with its own induced draught apparatus on the Ellis-Eaves principle,

as constructed by Messrs. John Brown & Co., Ltd., but with the addition of the air-heating apparatus patented by Mr. Fedden, the chief engineer, and successfully adopted in the old Sheaf Street station.

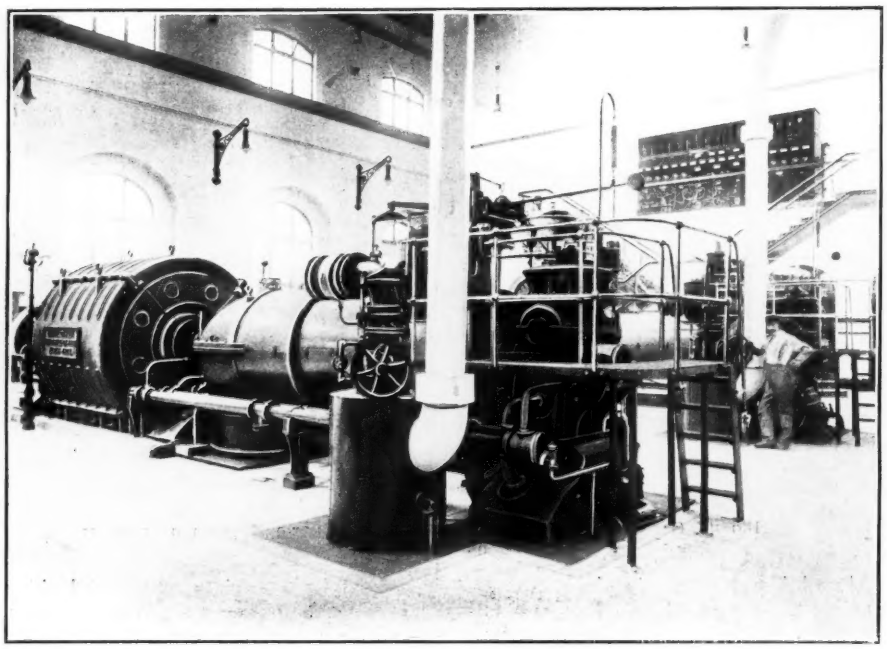


Fig. 6.—View of Engine Room, Showing 1,500-kw. Parsons Turbo-Alternators.

In the latter apparatus, air heating boxes, constructed of $\frac{3}{16}$ in. steel plates, and some 5 ft. 5 in. square × 15 ft. 5 in. high, are situated at the bases of the chimneys, which are themselves of steel, and 60 ft. high × 5 ft. diameter.

Inside the heating boxes are fitted some 423 tubes, $2\frac{3}{4}$ in. outside diameter, expanded into the top and bottom plates, up which the flue gases pass.

Air inlets are provided round the heating boxes and ducts connecting to the front and sides of the furnaces.

The air is drawn by means of Sturtevant fans, situated behind the boilers, through the heating boxes, ducts, fire bridges at the back of the grates, and through the front of the furnaces, between the fire bars, through the boilers, and by way of the tubes in the heating boxes through the fans and discharged up the chimneys.

Regulating dampers and bye-pass flues are provided so that any boiler may be worked with natural draught if desired.

The fans, situated on platforms at the rear of the boilers, are each capable of discharging 45,000 cb. ft. of air per minute, against a water pressure of $2\frac{1}{2}$ in. when running at a speed of 580 revolutions.

The fans are coupled to 35-B.H.P. two-phase motors, for the regulation of which a rheostat, giving six speeds, is provided, fixed on the wall beneath the fan platforms.

The arrangement of the boilers and induced draught plant will be made clear by reference to figs. 1 and 7. Each turbine set is connected direct to its boiler through a 7-in. diameter steampipe, an interconnection pipe of the same size, with isolating valves, being provided for obviating the necessity of a complete shut-down of the turbo-boiler unit, in case of either portion failing.

The steam connection to the pumps is in the form of an auxiliary ring main of 4-in. bore piping; the pipes being suspended from the boiler house roof, or carried on roller brackets to provide for expansion. The pipe arrangement over the boilers is clearly visible in fig. 2.

The whole of the steam-piping is wrot-steel lap-welded, with cast-steel tee-pieces, and has been supplied by Messrs. Tasker's Engineering Co., of Sheffield; the valves are of the Hopkinson parallel slide type, with cast-steel bodies and Platnam seats, for use with superheated steam.

For the pipe coverings the United Asbestos Co., Sheffield, were responsible.

The feed pumps are three in number, of the Worthington long-stroke vertical double acting pattern, any two being capable of feeding the four boilers, at present arranged for, when working at their full output.

They are fitted with gun-metal ends throughout, and the piston and pump rods are in sections with an intermediate coupling to facilitate independent removal.

When working at full load with 29 double strokes per minute the pump efficiency is stated to be 95 per cent.

The feed pumps draw their water from an overhead feed tank, built in three sections with a total capacity of 20,000 gallons. This tank is situated over the pump room, and the make-up water taken from the town main supply.

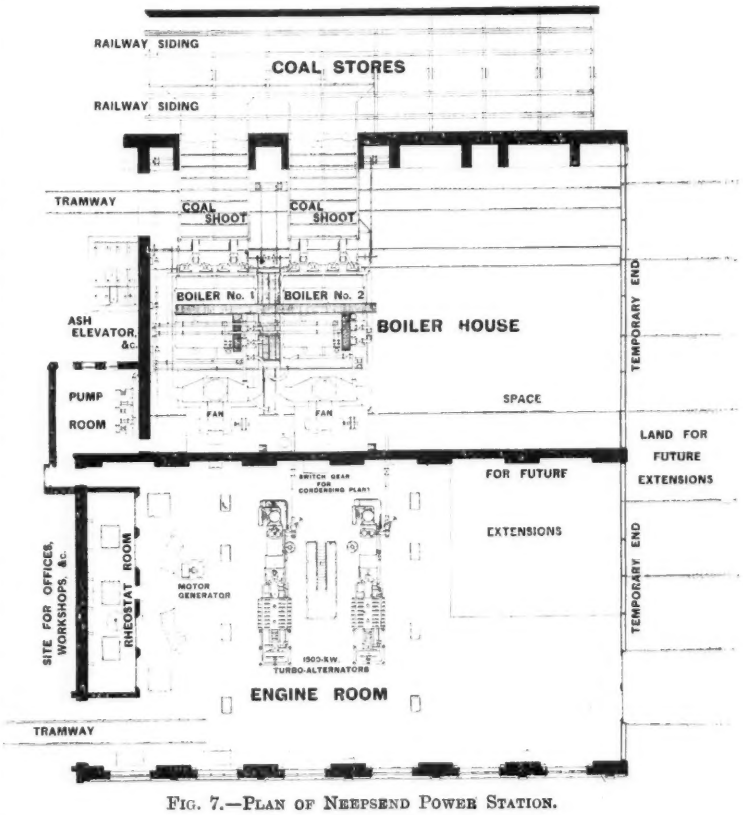


Fig. 7.—Plan of Neepsend Power Station.

The suction piping of cast-iron, with Fletcher valves, is arranged so that any pump can draw from any section of the tank and water level indicators are arranged on the wall of the pump room.

Duplicate boiler feed mains, of 6-in. bore cast-iron pipe, provided with vertical expansion bends, run over the front of the boilers, from which the feed connections to the rear drums are taken.

The blow-down cocks of the boilers discharge through copper piping into a main running into a blow-down tank. This latter is connected through a main drain to a brick culvert under the engine house basement, utilised for the circulating water.

(To be continued.)

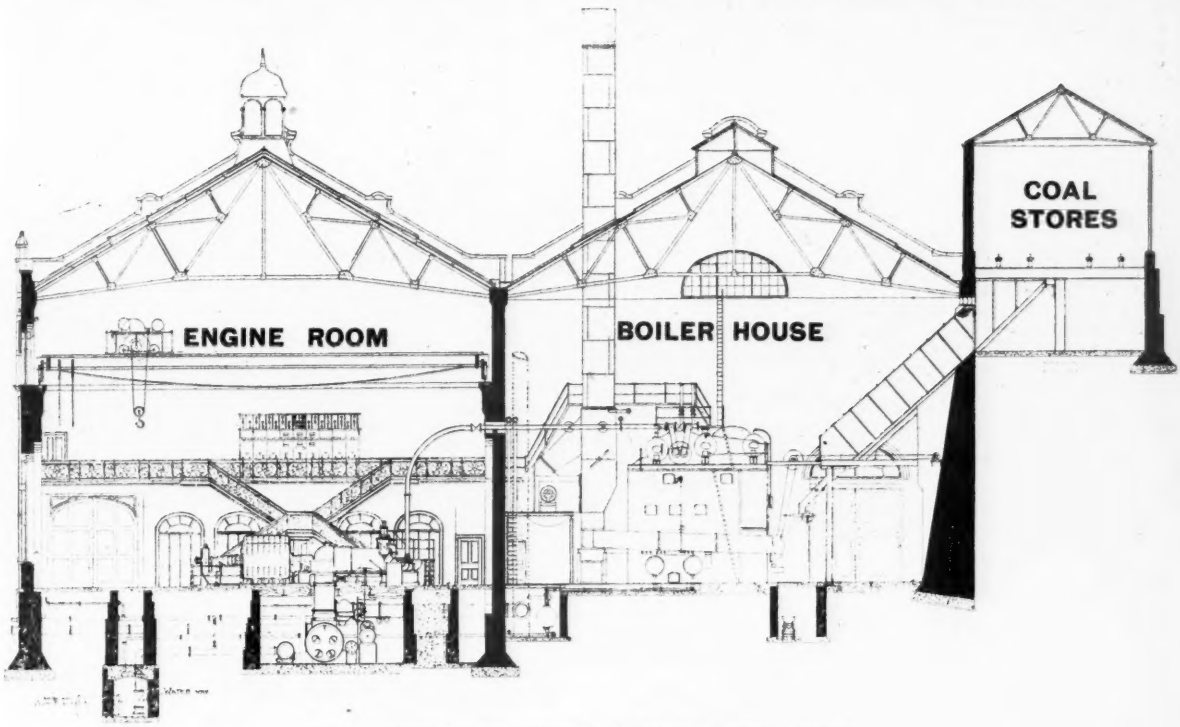


Fig. 8.—Cross-Section through Neepsend Power Station.

TRAMWAY AND RAILWAY NOTES.

(*Continued from page* 98.)

Brighton.—It has been known for some weeks past that a loss, probably a heavy one, will have to be faced on the working of the tramways. The report for the past year shows a deficit of £4,779. Nearly 11 millions of passengers have been carried, an increase of 566,000 on the previous year. A proposal to increase the fares all round has been left over for consideration at a special meeting. The chief items in the accounts are as follows:—Gross revenue, £46,264, as compared with £43,700 last year; expenditure, £40,359, as compared with £31,615 last year. The amount carried forward from revenue account is £5,908, as against £12,085 last year; charges for interest and sinking fund amount to £10,687, as compared with £7,949 in 1903. The reserve fund of £1,084 remains stationary.

France.—The departmental authorities of the Upper Savoy are considering a proposal with reference to the construction of an electric tramway between Flayet Saint Gervais and L'Aiguille du Goutier—a point well up on the way to Mont Blanc.

Glasgow Tramways.—The tenth annual report of the Tramways Committee of the Corporation of Glasgow for the year ending May 31st, 1904, has just been issued. The result of the year's working shows a revenue of £724,851, and working expenses, including depreciation, amounting to £496,266, leaving a gross balance of £228,584, thus showing an increase of £3,882. The gross balance of £228,584 has been applied in meeting interest and sinking fund, &c., on the cost of the Govan and Ibrox tramways, interest on capital, sinking fund, Parliamentary expenses, and annual payment to the common good; these payments amounting in all to £147,794. The net balance remaining amounts to £80,790, of which £62,000 has been applied in writing down the cost of buildings, ducts, cables, overhead equipment, and power station plant, the balance of £18,790 being added to the general reserve fund. Although the gross revenue for the past year shows an increase of £68,278 17s. 9d. over that of the previous year, the average traffic revenue per car-mile has decreased from 11·19d. to 10·58d. This decrease is chiefly due to the augmented service of cars which is now given on all routes. The average working expenditure per car-mile shows a slight increase from 5·21d. to 5·26d. This is due to the increase in taxes and accident insurance. The expenditure under each of the other headings of the revenue account shows a reduction per car-mile, as compared with the previous year. The Corporation has this year debited revenue with a proportion of the cost of obtaining the Tramways Orders of 1901 and 1903. It has also charged the past year's revenue with the whole cost of the Acts of 1891, 1893, and 1899. The total sum written off amounts to £12,864.

The net amount of borrowing powers as at May 31st, 1904, was £2,197,644. Additional borrowing powers to the extent of £100,000 have been asked under the Glasgow Corporation (Tramways, &c.) Order, 1904.

Since June 1st, 1903, 5 miles 9 yards of extensions to the system (all double track) have been opened. The total length of the tramways, including the above extensions, owned and leased by the Corporation, is 69 miles, double track; 5 furlongs, single track, the length of route being nearly 70 miles. The work of laying the lines in Finnieston Street, North Street, and St. George's Road is almost complete, the doubling of the Pollockshields line is being proceeded with, while a further portion of the extension in Clydebank is being carried out.

The Committee has decided to extend the Denniston depôt by covering all the available ground with car-sheds.

The total number of electric cars in stock is 682. The Corporation has decided to build 100 additional cars. The number of cars has been increased by 71 during the past year. Experiments are at present being carried out with different types of top covers on 12 cars; no final decision has yet been arrived at in this connection.

During the year the mileage covered was 16,291,082, and the passengers carried amounted to 188,962,610.

Greenock.—Bailie M'Callum, at Greenock Police Court, was called upon to decide whether the Corporation had power to make bye-laws other than those specified in the lease between the Greenock and Port Glasgow Tramway Co. and the Corporation. The point arose out of a charge against a car conductor of committing a breach of the bye-laws made by the magistrates for the regulation of car traffic, by permitting passengers to stand on the platform of the car. The bailie held that the magistrates were vested in the powers referred to.

Huddersfield.—The arrangements for the haulage of coal on the Corporation tramways from Hillhouse railway siding to the works of Messrs. Marten, Sons & Co., Ltd., Wellington Mills, Lindley, are nearing completion. The coal will be conveyed in motor-driven wagons, for each of which two men will be required. The distance covered will be about three miles.

Major Druitt, of the Board of Trade, on Wednesday, the 6th inst., inspected 330 yards of tramway which have been added to the Longwood section. He expressed satisfaction with the work, and gave permission for the cars to run over the new length.

Lincoln.—The Electricity Committee has taken over the tramways from the Lincoln Tramways Co. Sanction has been given to the purchase of electric tramcars, at a cost of £5,000.

London.—L.C.C.—The adjourned report of the Highways Committee was submitted recently, showing a deficiency of £8,283 on the working of the southern tramways during the year ended March 31st. Mr. T. P. Gaskell stated that the conduit system had broken down financially, and the number of accidents taking place was simply appalling. The stated loss of £8,283 was altogether misleading. If the tramways were properly rated, that would mean an additional loss of £15,839, and if a renewals fund had been provided, the loss for the year would have been £52,150.

Mr. H. P. Harris asked when the tramways would be worked at 5d. per car-mile as was estimated a few years ago, and also where the calculations made 12 months ago had failed to be realised.

Mr. J. A. Baker, in reply, stated that if the accounts were compared with the estimates placed before the Council in March, they ought to congratulate themselves upon the results as what had been assumed to be a loss of £15,000 had proved to be only £8,283. That was after setting aside no less than £100,000 for interest and sinking fund charges. The power used by the Council was costing £15,000 more than it should when the generating station at Greenwich was at work. Moreover, the Tooting and Greenwich lines were only open for electric traction a portion of the year. With regard to the cost of the conduit system, it had been ascertained that the expenditure, including special work at crossings, alterations to pipes and bridges, worked out at an average of £13,000 per mile of single track. That sum compared with an estimate of £7,500 for the overhead trolley system. The County Council's conduit lines were working as economically as overhead trolley lines in cities such as Manchester, Liverpool, Sheffield, and other towns. They would not have to reconstruct any overhead network every three years, and the conductors would last 25 years to 30 years, and the concrete longer. The track would require to be renewed, and the Council set aside a fund for that purpose.

Camberwell.—The B.C. has received letters from the London, Camberwell and Dulwich Tramways Co., stating:—(1) That instructions had been given to pull up the abandoned tramways Nos. 7 and 8, and make good the road; (2) That owing to Colonel Yorke's report on the condition of the other lines, the engineer had been instructed to place them in a proper state of repair. Further, that the company was trying to make arrangements for providing a proper service of cars on the tramways in question.

The B. of T. is inquiring into the issue of an order for the removal of the tramways.

Oldham.—The working of the Corporation tramways during the past year, has resulted in a loss of £8,000. Repeated alterations have been made in the fares to meet popular demands, but without result.

Paisley.—The Paisley to Johnstone section of the Paisley and District Electric Tramways was opened for traffic on Tuesday last. The opening of this section provides a continuous route from Glasgow to the centre of Johnstone, a distance of 4½ miles. A 10-minutes' service will be given from Paisley Cross to Johnstone. The other main route of the system, stretching from Potterhill, on the south side of Paisley, to Renfrew, is nearing completion.

Perth.—A scheme is on foot to develop the tramway system of the town and introduce electric traction. Efforts will be made, to make application to Parliament during next session, for a provisional order to construct the line.

Rhondda.—The U.D.C. having completed the purchase of the tramways in the town, has decided to invite offers for leasing them for a period of 42 years.

Salford.—The Corporation has submitted to the Bury Corporation proposals for a concession to Salford for running powers over portions of the Bury and Radcliffe tramway system. The matter has already been discussed privately. Formal proposals were placed before the Bury T.C. at its last meeting.

Stockport.—The negotiations between the Corporation and the Stockport and Hazel Grove Tramways Co. for the purchase of its tramway undertaking have come to an abrupt conclusion. The Council met last week to discuss the report of its committee, and it becoming known that the company were preparing to run a motor omnibus service shortly on this route, negotiations were, by resolution, broken off. The Hazel Grove route is regarded as one of the best leading out of the borough, and the company's lease has eight years to run. The Corporation has already come to terms with the Hazel Grove and Bramhall District Council for a lease of their lines through that district, in the event of terms being arranged for other parts of the system.

Torquay.—The T.C. has given instructions for plans of the proposed electric tramways (Dolter system) to be prepared, preparatory to the application for a loan.

Walsall.—It has been agreed to reduce the price of energy to the tramways to 2d. per unit until June 30th, and 1½d. per unit afterwards. The passenger receipts for the year are £8,200, as compared with £6,048 last year, or 11½d. per car-mile, as against 10½d., an increase of ¾ of 1d. per car-mile. The operating costs are rather over 4½d., as against 5d., or a decrease of nearly ½d. per car-mile. Maintenance and renewals are about the same, and general charges are ½d. lower than last year. The improved results obtained during the first period of the present year point to the possibility of earning a substantial profit.

West Cumberland.—Workington T.C. has approached the Maryport, Whitehaven and Cleator Moor Councils, with a view to ascertaining whether a joint scheme for electric tramways is feasible.

Wolverhampton.—The abstract of the accounts of the tramways undertaking for the year ended March 31st last, has just been issued. The horse traction has now entirely ceased, the last two routes, viz., the Dudley Road and Willenhall Road were closed in December, 1903, and January, 1904, respectively. Both these routes are now worked with electric traction, but no figures are given for the Willenhall Road line, as the new service did not commence till April last. As regards the horse traction account, it shows that the income in excess of working expenses amounted to £68, and as the sum of £1,344 had to be provided for interest, sinking fund and depreciation, the total loss for the year was £1,276. The electric traction account shows that the income in excess of working expenses amounted to £8,611 15s. 8d. Repayment of loans, interest, and sinking fund came to £6,488 3s., leaving a balance of £2,123 12s. 8d. The contribution to the renewals fund for the past year amounted to £3,213 13s. 6d., so that, after setting aside this amount, the loss on the year's account appears as £1,090 0s. 10d. It is stated that the total loss on the combined accounts since the acquisition by the Corporation of the tramways undertaking is as follows: Horse traction, £4,201 11s. 10d.; electric traction, £486 6s. 10d. = £4,687 18s. 8d. With respect to the loss of £486 6s. 10d. on the electric traction, it is pointed out that this is the net deficit after providing contributions to a renewals fund of £4,517 13s. 7d.

TELEGRAPH AND TELEPHONE NOTES.

Brighton.—With reference to the recently published figures of the balance-sheet, the receipts are only for the month, while the exchange had been working for five months, and the interest and sinking fund charges were for a whole year, and included capital charges on the system while under construction.

Postal Engineers.—Replying to a question in the House of Commons, Lord Stanley states that there is nothing in the evidence given before the Wages Committee that is inconsistent with the scheme for throwing open to competition a certain proportion of the vacancies for second-class engineers. The condition that candidates must have undergone at least two years' training in a suitable workshop attached to a college or University, or under a firm of electrical or mechanical engineers, applies to candidates for those vacancies which will be filled by open competition. Officers already in the service will be eligible for promotion to the much larger number of vacancies which will be filled as before, and in this case the requirement of two years' training does not apply. The limits of age recently fixed apply to open competition candidates only.—*Times.*

Telegraphic Rates.—The *London Gazette* of 8th inst. contains the revised schedule of rates for foreign and colonial telegrams which came into force on 1st inst.

Telephone Conference.—The conference between the delegates from the local authorities of London, on the telephone question was resumed at the Guildhall on Tuesday last. Mr. A. C. Morton, who was in the chair, read a letter from the Postmaster-General, in which he said he was convinced that the acquisition by the Government of the whole telephone system of the country in the near future, provided that the price to be paid is reasonable, would be more for the public advantage than a scheme for the purchase of the plant in the London area alone. In his view, the proper method of charge for an exchange service is that which was recommended by the Select Committee of 1898, under which the payments of the subscribers are fixed in proportion to their user. It was decided that copies of the letter should be sent to the local authorities of the London area, and that they be asked to bring the matter before their representatives in the House of Commons, with a view to protecting the interest of the telephone users, and also those of the taxpayers. The conference then adjourned *sine die.*—*Financial Times.*

Telephone Girls' Trade Union.—As the outcome of the recent strike among the female telephone operators at the Holborn exchange of the National Telephone Co., it has been decided to form a National Association of Telephone Operators.

University of Paris.—It is reported that the French Chamber has voted a credit for the creation of a professorship of physics in the University of Paris. M. Curie, the joint discoverer of radium, will be the first occupant of the new chair. It is passing strange that there should have been no chair of physics at the University hitherto; apparently we are not alone in our neglect of science.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—July 18th. Pipe-work for the electricity works. See "Official Notices" June 24th.

Batley.—July 16th. The Corporation invites tenders for a 350-KW. steam dynamo, and switchboard extensions. See "Official Notices" July 1st.

Bristol.—July 15th. Switchgear, water-tube boilers, two 1,000-KW. three-phase extra high-tension turbo-alternators, two 500-KW. induction type motor-generators, cables and transformers, for the Corporation electricity department. See "Official Notices" July 1st.

Bromley, Kent.—July 26th. A 15-KW. E.L. installation at the refuse destructor works. See "Official Notices" to-day.

Bulgaria.—August 13th. The Municipal Authorities of Phillippopolis are inviting tenders until August 13th for the concession for the electric lighting of the town and for the construction and working of an electric tramway.

Clyde.—July 25th. Two 32-ton electric coaling hoists for Clydebank Dock. See "Official Notices" June 17th.

Dartford.—July 19th. Mains extensions. See "Official Notices" July 1st.

Dover.—July 30th. Pumps and pipe work for the T.C. See "Official Notices" to-day.

Dublin.—July 22nd. Machinery oils for 12 months. See "Official Notices" July 8th.

Dundee.—The T.C. wants tenders for the purchase of a number of Ferranti meters, 5 to 600 amps., direct-current. See "Official Notices" to-day.

Fire Alarms.—July 15th. Tenders are invited for wiring several installations at York for the May-Oatway Fire Appliances, Ltd. See "Official Notices" July 8th.

Islington.—July 27th. Single-phase motor, and tail rods for engines. See "Official Notices" to-day.

Johannesburg.—July 29th. Steel work for car-shed buildings, and bridge over railway. See "Official Notices" June 17th.

Lincoln.—July 18th. Traction switchboard for the electricity works, and tramway feeder cables. See "Official Notices" July 8th.

London.—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

Metropolitan Asylums Board.—July 20th. Tenders for fire alarms at Darenth Asylum, Dartford, and for telephones at the Homerton and Fulham Hospitals. See "Official Notices" July 8th.

Plymouth.—July 21st. Electric light installation at the Municipal Technical School. Particulars from Mr. H. J. Snell, 11, The Crescent, Plymouth.

Plymouth.—August 15th. (1) Steam alternator; (2) Lancashire boilers with accessories. See "Official Notices" to-day.

Rochdale.—July 18th. Turbine and steam alternators; motor-alternator for electricity works extensions. See "Official Notices" July 1st.

Servia.—Tenders have just been invited by the Servian Ministry of Public Works for the establishment of a small plant for the electric lighting of the Royal Castle.

Shanghai.—July 30th. The Municipal Council invites tenders for a 24-mile electric trolley line concession. Particulars from J. Pook & Co., 63, Leadenhall Street, E.C., the London agents of the Council. See "Official Notices" May 13th.

Spain.—July 22nd. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders for the establishment and working of telephone exchanges at Lerida and at El Llano del Beal (Murcia province). Particulars may be obtained from, and tenders are to be sent to, La Direccion Général de Correos y Telegrafos, Calle de Carretas, 10, Madrid.

Spain.—July 30th. The Municipal Authorities of Belmez are inviting tenders until the 30th inst. for the concession for the electric lighting of Belmez, Pueblo Nuevo del Terrible, and Penarroya during a period of 7 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Belmez.

Spain.—August 4th. The Municipal Authorities of Fuentes de Andalucia are inviting tenders until August 4th for the concession for the electric lighting of the town during a period of 20 years. Tenders are to be sent to El Secretario del Ayuntamiento de Fuentes de Andalucia, whence particulars may be obtained.

St. Pancras.—July 19th. Main switchboard at King's Road station. See "Official Notices" June 24th.

Walthamstow.—July 22nd. Cables, troughing, boxes, &c., for two years, for the U.D.C. See "Official Notices" July 8th.

Walthamstow.—July 26th. Supply and erection of arc lamps. See "Official Notices" to-day.

West Ham.—July 15th. Removal and re-erection of four Babcock boilers. See "Official Notices" July 8th.

Whitby.—July 18th. Cables, network and service boxes for the U.D.C. See "Official Notices" July 1st.

Wigan.—July 19th. Booster, switchboard, balancer and cables. See "Official Notices" July 8th.

Wimbledon.—July 25th. Refuse destructor extensions for the U.D.C. See "Official Notices" July 8th.

CLOSED.

Bolton.—The Tramways Committee has accepted the tender of Messrs. Wm. Scott, Ltd., of Leeds, for the supply of 400 new steel rails.

Cheltenham.—The contract for the construction of the electric tramways from Cheltenham to Charlton Kings and Leckhampton, a distance of six miles, has been secured by Messrs. R. W. Blackwell and Co., Ltd., of London, the amount of the tender being £40,000.

Clyde Navigation Trust.—Messrs. Crompton & Co., Ltd., have received a contract for electrical stores during the current year.

Colchester.—The T.C. has accepted the following tenders:—Messrs. Davey, Paxman & Co., Ltd., M. C. C. Peache patent high-speed compound three-crank 550-H.P. engine, £1,320; W. T. Henley's Telegraph Works Co., Ltd., cables, £1,369 10s.

Hackney.—The B.C. has received the following tenders for electricity supply mains:—

Western Electric Co.		£8,718 15 1
British Insulated & Helsby Cables, Ltd.	(recommended)	8,749 13 8
Siemens Bros. & Co., Ltd.		8,990 7 11
Callender's Cable & Construction Co., Ltd.		9,017 19 8
W. T. Glover & Co., Ltd.		9,057 0 10
W. T. Henley's Telegraph Works Co.		9,195 8 9
St. Helens Cable Co., Ltd.		9,820 14 11

The B.C. has placed an order with Messrs. Reavell & Co., for an air compressor with a British Thomson-Houston motor, at £83 9s. 6d.

Hammersmith.—The B.C. has accepted tenders for the additional plant in connection with the extension of the electric lighting installation, the work being divided between Messrs. Richardsons, Westgarth & Co. and the British Thomson-Houston Co., at a total cost of £14,936 2s. 10d.

London.—The following tenders have been received by the London County Council for the installation of the electric light in the Poplar Technical Institute:—

Alliance Electrical Co., 137, Regent Street, W... ..	(accepted)	£666
Electrical & General Engineering Co., 17, Gracechurch Street, E.C.		718
Wenham & Walters, Vicarage Road, Croydon		770
Drake & Gorham, 66, Victoria Street, S.W.		787
J. H. Holmes & Co., 17, Soho Square, W.C.		790
Mossop & Co., 52, Queen Victoria Street, E.C.		940
Peacock & Jessop, 829, Goldhawk Road, W.		950

Marylebone.—The B.C. has accepted the tender of the Sunbeam Lamp Co., for the supply of electric lamps (Medical Dept.).

Rail Bonds.—The contracts for the supply of "Protected" rail bonds to the Royton and Crompton Tramways, and the Chesterfield Tramways, and also for solid forged bonds for the Aberdeen Tramways, have been placed with the Forest City Electric Co., of Piccadilly, Manchester.

Newport (Mon.).—The Corporation has accepted the following tenders:—The B.T.H. Co., at £51 for a 50-KW. transformer for the sub-station on Stow Hill; Messrs. Callender's C. and C. Co., 1,000 yds., for mains extensions, at £230.

Parkside Asylum, Macclesfield.—The Cheshire County Council has accepted the tender of Messrs. D. Firth & Sons, Cannon Street, Manchester, for Contract No. 1 (wiring and fittings), and the tender of Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, for Contract No. 2 (plant and main switchboard). Messrs. Lacey, Sillar & Leigh are the consulting engineers.

Salford.—The T.C. has accepted the tender of the Simplified Underground Conductor Co. for the supply of 260 yds. of three-wire cable at £58 10s.

West Ham.—The following is a list of tenders submitted for the electric wiring of the West Ham Park School for the West Ham Education Committee. The tender of the District Electric Co., of Wolverhampton, has been accepted :—

Noble & Co...	..	..	£960 10 0	Empire Electrical Co.	..	£521 12 9	
Tamplin & Makovski	..		769 10 0	Nunn Watts & Co.	..	517 4 0	
Winn, J.	..	..	661 5 0	Russell & Co.	..	505 9 0	
Electrical Eng. Co.	..		630 13 0	Glover & Co.	..	499 0 0	
Lawrences, Ltd.	..	..	630 0 0	Murrell Bros.	..	494 3 0	
Jackson Bros.	..	..	629 0 0	Simmons, W.	..	490 11 0	
Comyn, Ching & Co.	..		624 0 0	Bakewell & Co.	..	488 13 0	
Lightwell Electric Co.	..		620 0 0	Brown & Rostrom	..	485 8 8	
Halsey, J. T.	..	..	603 4 9	Donnison, Sillem & Co.		465 10 0	
Beaven & Son	..	..	596 8 8	Wright, Methuen & Co.		464 0 0	
Wallace & Co.	..	..	572 17 6	Wiedhofft, M.	..	441 0 0	
White & Co.	..	..	555 13 0	Defries & Son	..	435 10 0	
Wells, Rayner & Co.	..		528 15 0	Vulcan Electric Co.	..	400 0 0	
Richmond & Co.	..	..	528 0 0	Electric Motor Co.	..	324 10 0	
Marshall & Co.	..	..	527 13 0	Dist. Elec. Co. (accepted)		390 0 0	

It will be noted that the accepted tender is only one-third of the amount quoted by the highest tenderer.

Wolverhampton.—The T.C. has accepted the tenders of Henry Lovatt, Ltd., amounting to £107 15s. 7d., for the builders' work in connection with four concrete foundations, and of Isles, Ltd., of Stanningley, Leeds, amounting to £831, for the supply, delivery, and erection of electric crane and coal unloading apparatus, also at the generating station.

NOTES.

South African Notes.—*Zomba (British Central Africa).*—The supply of electricity to this town, in the northern part of South Africa, was commenced in March last. The plant is the property of the Administration of the British Central Africa Protectorate, and is used only for lighting the bungalows of the civil officials. The plant comprises a 24-in. diameter two-nozzle Pelton wheel of 26 H.P. worked with 180 ft. head of water. This Pelton wheel drives machinery, saws, planing machines, &c., in the carpenters' shop from 6 a.m. to 5 p.m., and is used from 6 p.m. to midnight to drive the two dynamos, each compound-wound, 800 r.p.m., 35 amperes capacity, at 220 volts. These are not coupled up either in series or parallel, but work independently. Some 33 bungalows are lit up at present, with a total of about 400 equivalent 8-C.P. lamps. The current is distributed from the electrical station along four main leads, of bare copper wire carried on wooden poles. These leads are protected from lightning by barbed wire running between the lead and return, and connected to earth at every alernate pole. Horn pattern lightning arresters are also provided at the distributing centres, connected to earth by copper plates, in contradistinction to the barbed wire earth plates of corrugated iron. So far, no street lighting has been carried out. Mr. J. T. Gosling, the then Postmaster-General, erected the whole plant from plans, &c., supplied by Messrs. Preece & Cardew, consulting electrical engineers to the Foreign Office. The chief surveyor, Mr. Thomas I. Binnie, is engineer for the time being. The capital expenditure per kilowatt installed is £36 4s. 6d., the total running cost being 4s. per 8-C.P. lamp per annum, including 5 per cent. interest on capital expenditure and 5 per cent. depreciation. The price per unit is 6s. per 8-C.P. lamp per annum, this basis of measurement being adopted to save book-keeping. The figures appear to be low all round. The staff is very small, no European's salary being chargeable, as the engineer has only a nominal appointment, and two natives, whose total wages are 35s. a month, keep the machinery in order. The installation is not run for a profit, the charges being arranged only to pay interest, depreciation, and working expenses.

Bloemfontein (O.R.C.).—The Town Council has passed a resolution to introduce a system of electric tramways. The Public Works Committee is preparing specifications, and advertisements calling for tenders for the concession are to be published in South Africa, America, and Europe.

Simon's Town.—A wireless telegraph station has been erected in the hills above the town, and experiments conducted between the station and gunboats in the Bay have proved highly successful.

Memorial to Sir G. G. Stokes.—Last week a medallion of Sir G. G. Stokes was unveiled by the Duke of Devonshire, Chancellor of the University of Cambridge, in Westminster Abbey, in the presence of Lords Kelvin and Rayleigh, Profs. J. Larmor (his successor), J. J. Thomson, Sir J. Dewar, and many other distinguished scientists and scholars.

The Brussels Central Station Controversy.—A correspondent writes:—"It is understood that the decision of the Municipal Council of Brussels, which was recorded in the REVIEW on July 1st, has come as a surprise to the town and the wide circle which has taken an interest in the controversy surrounding the proposed new central electric lighting station. As the existing station is inadequate to meet the present requirements, the Council resolved a long time ago to erect new works outside the town on land situated near the municipal gas works, and to transmit high-pressure current to sub-stations in the town for supply to consumers. Tenders were invited, and 12 schemes were sent in, these being submitted to a commission of electrical experts appointed by the Collège Echevinal. Ten of the tenders were rejected, and the commission selected two for further consideration. One of these was presented by the group A, called the German group, and composed of the Allgemeine Co. and the Union Co. The second, or B group, which is termed the Belgian group, consisted of the Compagnie Internationale d'Electricité, of Liège (the Pieper Co.), and the Société Electricité et Hydraulique, of Charleroi. As these two schemes, which the experts stated were of equal technical value, did not exactly conform to the requirements, the Collège Echevinal prepared a programme of the installations and opened a fresh competition between the groups A and B. On the report of the experts the Collège advised the acceptance of the tender of the A, or Allgemeine group, but the Municipal Council rejected the recommendation. Various proposals for arriving at a solution of the problem were then made by members of the Council, but while these were under consideration, a new scheme was sprung forth by the Parisienne Electrique, which offered to erect works and deliver low tension current to the Municipal Council for distribution to consumers. This French company is apparently headed by MM. Empain, who are well-known Belgian financiers, and who are interested in electrical companies in Paris. On the last day of the discussion of the question, the Allgemeine Co. intimated that it would agree to guarantee that the works it proposed to carry out would enable the town to produce current at the price fixed by the Parisienne Electrique. The Council rejected a member's proposal to award the contract to the Belgian group, and the mayor then put to the vote a recommendation in favour of accepting the tender of the Allgemeine Co. This was carried, as mentioned in a previous issue, by 30 votes to 8. It has, therefore, been impossible for the Council to express any opinion on the motion of M. Hallet, to invite fresh tenders, or on that of M. Depaire to ask for offers for the works in various sections; nor has it been possible for the terms submitted by the Parisienne Electrique to be discussed and voted upon by the Council. The latter company is now seeking compensation at Liège, where a large power station is to be built for the working of the tramways and also for supply to the Liège-Seraing Co."

The details of the contract are as follows:—The Allgemeine-Union Cos. undertake to carry out the work for the sum of 3,090,400 fr. The buildings will cost 1,285,000 fr. The contractors guarantee that, during a period of 10 years, the cost of energy in the form of three-phase current delivered to the sub-stations at high pressure shall not exceed 10 centimes per KW.-hour, and in the form of direct current at low pressure leaving the sub-stations, 18·5 centimes, provided that the input to the sub-stations shall not be less than 6,467,000 KW.-hours per annum, and the output 5,250,000 KW.-hours, the efficiency of the sub-station plant being reckoned at 81·2 per cent. The price of energy delivered to the consumers would have to be increased by about 13 per cent. to allow for the losses in the distributing system, say, 2·4 centimes per unit. Under the terms of their guarantee, the contractors undertake to pay annually to the town, during the aforesaid period, the difference between these figures and those actually realised. The calculations are based upon data adopted by the Collège Echevinal, with regard to the price of fuel, depreciation of plant, &c.: salaries, wages, stores, maintenance, &c., as well as interest and depreciation on capital, will be determined according to each year's results.

In the foregoing guaranty no distinction is made between the purposes for which the energy is to be used. The municipality, however, will supply electricity for industrial purposes at 20 to 25 centimes per unit, the capital charges being mainly defrayed by the electric light consumers. The contractors undertake to commence supply from the new works in the winter of 1905, and to completely finish the installation by October 1st, 1906.

St. Louis International Electrical Congress.—We have received from Mr. G. C. Lloyd, secretary of the I.E.E., a copy of the detailed programme issued by the American Institute of Electrical Engineers in connection with the Congress named above. The programme gives full particulars of the itinerary prepared for the European visitors, who have been so cordially invited by their Trans-Atlantic *confrères* to visit the Exposition and the principal industrial centres of the United States. The British contingent leaves by the steamer *Republic* on August 25th, and the utmost endeavours have been put forth by the American Institute to ensure that the tour shall be crowned with success in every possible direction. Having received the programme whilst going to Press, we must defer more detailed reference to it to our next issue; but we may mention that, from private information which has reached our hands, the members of the American Institute are most anxious that the occasion shall be a memorable one. No expense will be spared towards this end—a sum of £2,000 has already been raised—and the arrangements are such that the visitors can see the best of America, be received by the best of the electrical fraternity, and be gone from England five weeks, at an absolutely inclusive cost of £70 each. The opportunity is one that may not recur, and those who can spare the time will be well advised if they take advantage of it.

Junior Institution of Engineers.—Visits of this Institution were recently paid to the Chelsea generating station of the Underground Electric Railways Co. of London, Lot's Road, Chelsea, and to the adjoining London County Council pumping station. At the former place the general manager, Mr. J. R. Chapman, and the resident engineer, Mr. J. W. Towle, were present, and the visitors were enabled to make a complete examination of the work so far as it had advanced.

State Endowment of Universities.—Mr. Balfour will, to-day, receive an important deputation on the subject of the State endowment of Universities. The deputation has been organised by the British Association, and the leading part in its promotion has been taken by Sir Norman Lockyer, whose address last year as President emphasized the urgent need of improved educational facilities.

Appointments Vacant.—The Council of the University of Birmingham invites applications for the Chair of Electrical Engineering; salary £1,000 per annum, with liberty to carry on a consulting practice. Switchboard attendants for Lancaster and Bermondsey. The Marylebone B.C. invites applications for the following:—Resident engineer, mains superintendent, installation inspector, meter department superintendent, and an accountant for the electricity department. See "Official Notices" to-day.

Obituary.—Mr. Francis E. Macmahon, inventor of the "tape ticker," died at Newmarket on Tuesday last week. His chief invention, the ticker, which he sold to the Exchange Telegraph Co., was first tested in 1881 at Epsom.

Superheat and the Willans Engine.—We have received a pamphlet on the use of superheated steam as applied to the Willans engine. As everyone knows, the main feature of the Willans engine as regards dryness of steam is its central valve and drainage at piston level. It is unfortunate that the use of a central valve adds a very large percentage indeed to the internal surfaces of the cylinders exposed to the entering steam, and this additional surface increases the condensation effects due to interchange of heat between the steam and the cylinder metal without performance of useful work. In such an engine, therefore, the economy of good drainage is more or less nullified by the additional surface.

To the class of central valve engines, therefore, the use of superheated steam is peculiarly welcome, for it at once minimises the cylinder condensation effects. This is shown by the pamphlet before us, which details in graphic form the saving in thermal units given to the feed water and the percentage of saving in feed water per I.H.P.-hour. In each case the percentage saving of water per I.H.P.-hour is somewhat greater than the saving of heat given to the feed. Three diagrams are given for simple, compound and triple-expansion engines, while a fourth chart gives curves of steam consumption for a 210-B.H.P. engine at varying loads and varying degrees of superheat, the engine being of triple-expansion type condensing and run at 400 r.p.m., with steam at 185 lbs. In this engine, with 250° F. of superheat, the steam per B.H.P.-hour is 10 lbs. at full-load, against about 14·66 lbs. with saturated steam. At quarter-load the consumption figures are 12·5 lbs. and 20 lbs. respectively. Below half-load the effect of non-superheated steam shows up very badly. With 220° of superheat at the stop valve of a non-condensing simple engine, the steam consumption is nearly 36 per cent. less than for saturated steam. In the compound engine the saving with 180° of superheat is 23·5 per cent.; in the triple engine it is about 24 per cent. The triple-expansion condensing engine gains more than the compound engine. It is concluded, as a result of the tests, that without any alteration, the Willans engine will work with superheated steam of the highest temperatures. Anyone having Willans engines may, therefore, safely apply superheat without fear of bad effects following.

The percentage of heat saving is less than the percentage of steam saved in all the diagrams, but no information is given as to the nature of the superheater employed. If, however, it is of the small tube separately fired type with the temperature of the furnace gases reduced by air drenching to a safe point, it may be pointed out that good as is the economy of heat shown, the results would be even better with a rational system in which the furnace temperature was fully utilised. The pamphlet generally strongly points the economy of superheat.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—Mr. JOHN MCMILLAN, chief electrical engineer to the Falkirk Corporation, was met on Tuesday, 12th inst., by the assistants and staff at the Corporation Electricity Works, and presented with a drawing room spirit kettle as a marriage gift. The presentation was made by Mr. Wm. Drysdale, A.M.I.E.E., the chief assistant engineer, who spoke of the kindly feelings which existed between the chief and his staff. Mr. McMillan suitably thanked his staff for the gift and the expression of their goodwill.

St. Helens T.C. has increased the salary of Mr. E. M. HOLLINGSWORTH, electrical engineer, from £350 to £400 per year.

Mr. PRICE WHITE, electrical engineer to the Bangor T.C., having been appointed consulting electrical engineer in connection with the Carnarvon Corporation electric lighting scheme, the T.C. has postponed the increase in his salary recently voted until April next year.

Bermondsey B.C. has increased the salary of Mr. W. H. VINCENT, the borough electrical engineer.

Mr. R. R. WILLIAMS, of Manchester Corporation electricity works, has been appointed to the post of charge engineer at the Bristol electricity works.

The Ealing Electric Supply Committee has granted Mr. J. DOUGLAS KNIGHT, the borough electrical engineer, leave of absence for the purpose of visiting America.

Out of 85 applicants for the post of resident engineer, Limerick, the following have been placed on the short list:—Messrs. A. J. Abraham, Partick; C. Cummings, Hull; C. H. Klyne, King's Lynn; J. P. Gallinagh, St. Patrick's College, Maynooth.

General.—Mr. F. J. HUGHES, late Clerk-in-Charge of H.M. Posts and Telegraphs, Gold Coast Colony, West Africa, and formerly of the Great Western Railway telegraph staff, has been appointed Inspector of Telegraphs, H.M. Southern Nigerian Colony.

Mr. J. G. ELLIS, office manager of the Newport (Mon.) Corporation electricity works, has been granted a month's leave of absence on account of ill-health.

Mr. F. J. MADGEN, on resigning the post of Sussex district manager of the National Telephone Co., has been presented by the local staff with a a gold albert and a pair of silver entrée dishes.

Mr. R. NAKAYAMA and Mr. K. KAWASUMI, belonging to the Japanese staff of electrical engineers attached to the Department of Communications, who have been studying British methods at the Central Telegraph Department of the General Post Office, have left London for France. They will afterwards proceed to Switzerland and Germany, returning to Tokio in December.

NEW COMPANIES REGISTERED.

Farnham and District Electricity Supply Co., Ltd. (81,401).—This company was registered on June 29th, with a capital of £1,000 in £1 shares, to carry on the business of an electric light and power company in all its branches, to fix, construct, lay down and maintain all necessary cables, wires, lines, accumulators, lamps and works for the purposes of such business, to construct or acquire any tramways in or near Farnham, &c. The first subscribers (each with one share) are:—G. F. Roumien, Willey Park, Farnham, Surrey, barrister; R. D. Kingham, Parkleigh, Farnham, merchant; A. J. Kingham, Avon Lodge, Farnham, merchant; J. H. Wilson, Farnham, outfitter; A. H. Guyer, Farnham, architect; W. T. Pressland, Broad Sanctuary Chambers, S.W., electrical engineer; and A. J. Fippard, Broad Sanctuary Chambers, S.W., electrical engineer. No initial public issue. The subscribers are to appoint the first directors; qualification, £100; remuneration as fixed by the company. Registered office, York Mansion, Westminster, S.W.

R. H. Longbotham & Co., Ltd. (81,481).—This company was registered on July 5th, with a capital of £10,000 in £1 shares, to acquire the business carried on by R. H. Longbotham, at Ings Foundry, Wakefield, and at Newcastle-on-Tyne, as "R. H. Longbotham & Co.," to manufacture and deal in machinery, implements, rolling stock, instruments, tool apparatus, and hardware of all kinds, and to carry on the business of electrical, mechanical, hydraulic, gas, mining and general engineers, electricians, makers, storers, distributors and suppliers of electricity, gas, steam, water, or other force for light, heat, motive power or other purposes, &c. The first subscribers (each with one share) are:—R. H. Longbotham, Walton Grange, Wakefield, engineer; Mrs. E. Longbotham, Walton Grange, Wakefield; W. N. Hemingway, Rook's Nest, Stanley, Wakefield, engineer; J. S. Longbotham, 7, Portobello Road, Wakefield, engineer; C. Padgett, 34, Lawefield Road, Wakefield, book-keeper; J. H. M. Cragg, 12, Clayton Road, Jesmond, Newcastle-on-Tyne, engineer; and G. A. Longbotham, Walton Grange, Wakefield, engineer. No initial public issue. The number of directors is not to be less than two nor more than five; the first are R. H. Longbotham (permanent special qualification, £4,000), W. N. Hemingway, and G. A. Longbotham. Ordinary qualification, £100; remuneration as fixed by the company. Registered office, Ings Foundry, Ings Road, Wakefield.

Conduits and Fittings, Ltd. (81,348).—This company was registered on June 25th, with a capital of £5,000, in £1 shares (3,000 preference), to adopt agreements with W. H. McCandlish, D. M. Edwards, and E. A. Brown, and to carry on the business of manufacturers of and dealers in conduits, fittings, electric light instalments, tubes and electrical machinery and appliances, iron-founders, mechanical and electrical engineers, electricians, founders, smiths, metal converters, millwrights, &c. The subscribers (each with one share) are:—J. A. McCandlish, 17, Cockspur Street, W., merchant; H. W. Dawson, 3, Westminster Mansions, S.W., gentleman; W. H. McCandlish, 6, Manor Place, W., engineer; C. J. Halliday, 4, Park Place, St. James's, S.W., gentleman; G. G. L. McCandlish, 4, St. Helen's Place, E.C., solicitor; E. H. D'Oyly, 18, New Square, Lincoln's Inn, W.C., architect; H. Lee-Dillon, J.P., Ditchley, Enstone, Oxon. No initial public issue. The number of directors is not to be less than two nor more than five: the first are H. L. Clark (chairman), J. A. McCandlish, H. W. Dawson and W. H. McCandlish (managing director): qualification, £100; remuneration (except managing director), £100 per annum. Registered office, 5, Old Queen Street, Westminster.

Kingsbridge and South Devon Electric Lighting and Traction Co., Ltd. (81,440).—This company was registered on July 1st, with a capital of £2,000 in 1,920 ordinary shares of £1 each and 200 deferred shares of 1s. each, to carry on at Kingsbridge, Salcombe, and elsewhere in Devonshire, the business of an electric lighting and power company in all its branches, and to contract, fix, and maintain any necessary generating stations, cables, wires, lines, accumulators, lamps, works, and conveniences, &c. The first subscribers (each with one deferred share) are:—J. R. Parkin, 9, Burton Street, Westminster, S.W., civil engineer; D. T. Gregson, 19, Medlar Street, Camberwell New Road, S.E., electrical engineer; F. W. Sturton, 192, Broadfield Road, Catford, S.E., accountant; C. H. Brown, Mayfield, Walton-on-Thames, surveyor; A. Wright, 48, Burton Crescent, Tavistock Square, W.C., clerk; A. G. Field, 13, Guildford Street, Luton, clerk; O. B. Thomas, 4, Lydon Road, Clapham Common, S.W., solicitor. No initial public issue; registered without articles of association. The first directors are J. R. Parker, D. T. Gregson, F. W. Sturton, C. H. Brown, A. Wright, A. G. Field, and O. B. Thomas. Registered office, 25, Victoria Street, S.W.

Paddington Electric Supply Co., Ltd (81,426).—This company was registered on June 30th, with a capital of £1,000 in £1 shares, to carry on the business of electrical, mechanical, and chemical engineers, electricians, contractors, suppliers of light, heat, sound, and power by electricity, galvanism, magnetism or otherwise, manufacturers of electrical apparatus, &c. The first subscribers (each with one share) are:—E. Boulnois, M.P., 29, Westbourne Terrace, Hyde Park, W; W. Haynes Fisher, M.P., 13, Buckingham Palace Gardens, London; E. J. A. Balfour, 32, Addison Road, W., architect; W. Leaf, Litt.D., 6, Sussex Place, Regent's Park, N.W.; E. Bax, Eldon, Weybridge, director; M. R. Pryor, 63, Threadneedle Street, E.C., merchant; and F. J. Walker, 19, Carnaby Street, Golden Square, W., secretary. No initial public issue. The subscribers are to appoint the first directors. Registered office, 19, Carnaby Street, Golden Square, W.

Bishop's Stortford and Stanstead Electric Lighting Co., Ltd. (81,397.)—This company was registered on June 29th, with a capital of £1,000 in £1 shares, to carry on at Bishop's Stortford, Herts, and Stanstead, Essex, and elsewhere, the business of suppliers of electricity for light, heat, motive power or otherwise, electricians, engineers, contractors, &c. The first subscribers (each with one share) are:—E. A. Young, Stanstead, Essex, electrical engineer; A. F. W. Ogilvie, 30, Budge Row, Cannon Street, E.C., solicitor; J. W. Field, 18, Lysias Road, Balham, S.W., clerk; A. J. Nightingale, 2, William Street, Tottenham, N., clerk; H. C. Bennett, 26, Granville Road, Walthamstow, managing clerk; H. Spearing, 4, Isabella Road, N.E., clerk; and E. Vaughan, 5, St. John's Park Mansions, Pemberton Gardens, N., clerk. No initial public issue. The number of directors is not to be less than three nor more than five. The subscribers are to appoint the first.

ELECTRICITY SUPPLY ACCOUNTS.

Belfast Municipal Electricity Supply.

We give herewith the returns of the Belfast Electricity Department for the last year of working. This period has been prolific in results, gratifying alike to the city and its electrical engineer. With a largely increased output and revenue, but a small addition has been made to the working costs, and the surplus available for financial charges, &c., is correspondingly improved. The load factor at Belfast, though still poor, is an improvement on the previous year, and under these conditions the average working costs (including public lighting) at 1·06d. per unit are very creditable.

The prices charged are:—Private lighting, 6d. and 1½d. per unit; power, 2½d. and 1d. per unit, maximum demand system; public arcs, £15 per annum; incandescents, £2 7s. 6d. per 32-c.p. lamp per annum. The chief engineer is Mr. V. A. H. M'Cowen.

Year.	Units sold.	Working cost per unit.	Int. and sink. fund per unit.	Total cost per unit.	Total average price obtained per unit.
1899	622,486	2·21d.	1·47d.	3·68d.	4·50d.
1900-1	908,067	1·88d.	1·92d.	3·81d.	3·93d.
1901-2	1,205,697	1·79d.	1·87d.	3·66d.	3·59d.
1902-3	1,665,560	1·29d.	1·57d.	2·87d.	3·24d.
1903-4	2,255,579	1·06d.	1·21d.	2·28d.	2·92d.

General Statement.

For year ending March 31st—	1904.	1903.
Total capital expended	£230,265	£217,124
Number of units sold—		
Private supply	2,236,148	1,652,962
Public lighting	19,431	12,598
Total number of units sold ...	2,255,579	1,665,560
Equivalent No. of 8-c.p. lamps connected	171,845	122,000
H.P. of motors connected	2,060 H.P.	1,360 H.P.
Number of public lamps	4 arc 56 inc.	60 inc.
Maximum load in KW.	2,190	1,968
Revenue account—		
Gross revenue	£27,532	£22,536
„ expenditure	£10,008	£9,004
„ profit	£17,824	£13,512
Average inclusive price obtained per unit—		
Private lighting...	2·94d.	3·26d.
Public lighting	1·31d.	1·31d.

Revenue Account for Year ending March 31st, 1904.

Gross revenue	£27,532 =	2·93d. per unit.
Works and distribution costs (including public lighting)	£7,415 =	·79d. „
Total working costs	£10,008 =	1·06d. „

Profit Statement.

Interest on loans	£6,950
Sinking fund	4,636
Balance carried forward	6,348
Balance brought forward from last account ...	—410
Gross profit	£17,524

CITY NOTES.

The National Telephone Co.

The report of the directors for the half-year ending June 30th, 1904, to be presented at the meeting on Friday, the 22nd inst., at 11 a.m., shows that the income for the half-year amounts to £984,600 8s. (£894,583 8s. 5d. for the corresponding period of 1903), being an increase of £90,016 19s. 7d. The working expenses for the half-year amount to £567,071 18s. 6d. (£509,414 in 1903), an increase of £57,657 18s. 6d. The net result for the half-year (after deducting the Post Office Royalties amounting to £90,702 18s. 7d.) is a profit balance of £326,825 10s. 11d. (£303,156 19s. 7d. in 1903) an increase of £23,668 11s. 4d. The rentals carried forward for unexpired terms of running contracts amounts to £937,296 18s. 1d. (£874,383 1s. 10d., 1903), an increase of £62,913 14s. 3d. Out of the available balance of £258,286 9s. 10d. the board will recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 5 per cent. per annum on the deferred stock, less income-tax in all cases. The board also propose to transfer £100,000 to the reserve fund, and to carry forward the balance of £9,369 16s. 6d. The sum of £394,654 4s. 9d. has been expended on capital account during the half-year in the erection of 19,615 additional stations, and in the construction of underground works. Three directors retire, and being eligible, offer themselves for re-election, viz., Sir J. Fergusson, Mr. S. H. Sands, and Sir J. T. Woodhouse. The auditors, Messrs. Welton, Jones & Co., also retire, and are eligible for re-election.

British Electric Traction Co.

Sir Charles Rivers Wilson, chairman, presided at Winchester House on Monday over the eighth ordinary meeting of the above company, and in moving the adoption of the report, said the net profit for the year was £249,817, as against £222,836 last year. The increase in the profit was entirely represented by an increased productiveness of their investments in the associated companies. In fact, this source of their income was increasing, while the other sources of profit were, in the aggregate, diminishing. This was a very satisfactory feature, because it was mainly in this direction that they would have to look for their profits in the future. The total amount they had received in respect of dividends on shares, interest on debentures, consols, loans, and deposits, and on purchase monies unpaid was £171,369, as against £138,000 in the preceding year. The net profit on the working of the Croydon, Barrow, Brighton, Mumbles, and Pontypridd undertakings was £3,879. The reason why these profits were shown as a separate item was that there were undertakings worked by the company itself. They were managed by committees of the company's officers in the same way as if they were separate undertakings, and the accounts were all separately audited. Some of them, like the Pontypridd, which the company were holding until purchased by the local authorities, were carried on at a slight loss, but the net profit on the whole of them was £3,879. The next item was £51,250, being the profit on the sale of undertakings and of sundry rights and interests in undertakings. This was an item which would continue to appear so long as they had any rights or properties which they found it to the interests of the shareholders to dispose of. Hire of rolling stock and rent was £2,305, which was accounted for by some of the associated companies hiring rolling stock temporarily. The net profit on the sales of investments was £1,375, and this was an item which varied a great deal, as opportunities arose for disposing of investments. In cases where they had a controlling interest in a company in the form of ordinary shares, they did not think it good finance to hold preference shares and debentures of the companies upon which they only received about 4½ per cent. on the average. Profits and commissions on contracts were £18,686, and the net profit on engineering and other services rendered was £2,944. They had a large technical staff employed for doing engineering and other work for the associated companies, and they charged the companies for such services rather less than they would have to pay to others, so that the arrangement was good for both sides. The next item was £10,365 in respect of fees and commission paid into the treasury of the company by directors and staff, and amounts received for provision of office accommodation, &c. The shareholders knew the system they adopted by which they nominated directors to the associated companies, and provided office accommodation, and the fees paid to such directors accrued to the company. The last item was £25,312, being the net profit on shares and debentures underwritten, but taken up by others. This was a financial profit which varied from year to year, according to the state of the money market, and the success they had in getting the shares of the associated companies underwritten by others. It was, however, an item which was likely to diminish in the future. The chairman proceeded to deal with the items on the debit side of the profit and loss account, and said that £6,925 had been written off as loss on undertakings not proceeded with. This was the expense incurred in obtaining Acts of Parliament, light railway orders, and so on, which did not appear likely to lead to business. Of course, as they restricted their business, this loss would diminish, but as an illustration of the fact that it was not money irretrievably lost, he might say that they received over £4,000 this year on account of an item which had been written off. The item of £10,607 was an altogether exceptional item, and arose mainly through experiments they thought it right to make in connection with the new motor haulage industry. It was necessary for them to watch carefully all new developments, and to adopt any new method of traction which offered advantages for its employment. For these reasons they had made sundry investments and experiments in connection with motor haulage vehicles and omnibuses, and the whole of the expense incurred had been written off. They had also thought it right to write off the whole of the amounts standing to the credit of licenses account, viz., £4,575, and also £1,000 from the stores account. The result was that they had a sum of £249,817 to transfer to the net revenue account, and this, with the balance of £24,912 brought forward, gave an available sum for appropriation of £274,730. From this £63,704 had to be deducted for debenture interest, as against £45,165 last year, and the preference dividend amounted to £92,896, as against £74,760 in the preceding year. A final dividend was recommended making 6 per cent. for the year, and leaving £38,148 to be carried forward, as against £24,912 last year. They therefore paid 2 per cent. less dividend, and carried forward £13,236 more. The chief reason for the smaller dividend was that, although the amounts received showed a satisfactory increase, yet a large proportion of capital had not yet had time to become revenue earning, and taking all the circumstances into consideration, the directors considered it more in the permanent interest of the company to reduce the dividend. It was a matter of importance, however, for the shareholders to recognise the very great progress which had been made by the company. They were now operating nearly 400 miles of tramways and light railways, as against 200 miles five years ago, and last year carried 220,000,000 passengers, as against 55,000,000 in 1899, and the total traffic receipts were £1,162,000, as against £315,000 in 1899. But even these figures did not show the real progress made, and probably the best figure for comparison was to take the number of passengers carried and the receipts per route mile. In 1899 they carried per route mile 255,000, and the receipts were £1,455 per route mile, while last year they carried 544,000, and the receipts were close on £3,000.

This was done, it had to be remembered, in a year which was exceptionally wet. In 1899 the majority of the lines were worked by horse traction, while last year the majority were worked by electric traction, and this adoption of electrical traction meant reduced working expenses. Dealing next with the balance-sheet, the chairman pointed out that there was an increase in the item of debentures of £570,357, and in the reserve fund of £30,000, but this increase of capital was represented on the asset side by increases of investments and of debtors, and as the debtors were the associated companies, practically the whole of the increased capital was represented by their increased interests in the associated companies. He thought the increase of capital was fully justified, although he admitted it would have been better if they could have postponed the construction of tramways for a time. The fact was, however, that although they were strongly opposed by local authorities when applying for Parliamentary powers, yet no sooner did they get the powers than they were urged to proceed with the work. The chairman next dealt at length with the progress made in connection with the various schemes of the company. He pointed out that although the Birmingham Corporation had decided to municipalise the tramways, yet they had granted the company running powers over certain lines. Important progress had been made with the electrification of the tramways belonging to the Metropolitan Tramways Co., in which they had an interest of £250,000. They had not yet received any return on the greater part of that, but an important section would soon be open, and they anticipated that a profit would soon be made. Their Auckland (New Zealand) investment, in which they had £287,360, became productive during the year. It was hoped that the award would be soon given as to the amount to be paid by the Bournemouth Corporation for the purchase of the Poole Traction Co.'s undertaking. With regard to the Pontypridd and Yarmouth undertakings, all the expenses in respect to the endeavour to obtain extensions had been written off, and it was expected that the amount they would receive from the local authorities would cover what they paid for the undertakings. Their present policy was to limit as far as possible further capital commitments of the company. They would not enter upon any new schemes, but would complete what they had undertaken, and he was glad to inform the shareholders that financial arrangements had been made for this, and he believed any public issue of capital for the company would be unnecessary for some time to come.

Mr. E. GARCKE seconded the motion, which was carried, after a short discussion.

Chili Telephone Co.

THE directors' report for the year ended March 31st, 1904, to be presented at the meeting on July 20th, says that the aggregate number of subscribers at all centres at the end of the year was 5,814 as compared with 5,371 at the beginning, or a gain of 443 for the year.

The gross revenue in Chili from all sources was:—In 1903-4, $916,542; in 1902-3, $841,193; an increase of $75,349.

The expenditure in Chili was:—In 1903-4, $422,409; in 1902-3, $401,519=an increase of $20,890.

The net income in Chili from all sources was:—In 1903-4, $494,133; in 1902-3, $439,674=an increase of $54,459.

The average rate of exchange for the year was 16·36d., as compared with 15·68d. in the previous year, giving an increase for the year of 0·68d. Converted into sterling at these rates, the figures given in the preceding paragraph are:—

In 1903-4	£33,687
In 1902-3	28,723
An increase of	£4,964

The balance to the credit of the revenue account, including £2,637 brought from the previous year, is £31,207, of which £14,010 has been carried to reserve for renewal of plant, &c. An interim dividend of 3s. per share, less income-tax, was paid on January 14th last, and the directors now recommend a final dividend of 4s. per share, less income-tax, making 7 per cent. for the year, and leaving a balance of £2,502 to be carried forward. Of the debentures which matured on March 31st this year, £21,000 has been paid off, and arrangements have been made to extend the remainder, amounting to £35,000, until such time as the finances of the company will permit of their being also paid off. The total mileage was:—

	Miles.	Yards.
On March 31st, 1904..	9,884	468
,, ,, 1903..	9,205	892
An increase of	678	1,386

Greenwood & Batley, Ltd.

THE sixteenth ordinary general meeting of this company was held at the offices, 16, Gt. George Street, Westminster, on Saturday last week.

In the absence, through illness, of Mr. Henry Greenwood, the chair was taken by Mr. J. H. Wurtzburg.

The CHAIRMAN, in moving the adoption of the report and balance sheet, said that it was satisfactory to note that the net profits earned were £6,800 more than in the previous year, and if they did not reach the high figures of the years ending March 31st, 1901 and 1902, it should be remembered that the profit of those two years was abnormal, and largely due to the extraordinary requirements for war material during the South African war. Last year's profit was well above the average of the past five years, including the two years referred to. The electrical department continued to make good progress, so much so that it had been found necessary to provide additional room and power for the development of this branch. The manufacture of chassis for electrically-propelled motor-cars had given good employment, and about 100 of those carriages had been made and supplied by the company to the Electromobile Co. during the year. These landaulettes and broughams were running most successfully in London. The tool department had been kept fairly well employed on orders for special machinery, but the ordinary general tool trade had been dull. In the ordnance department, although they had had no complete torpedoes to make, the branch had been kept busy on orders for new parts, replacements, spare gear and other torpedo fittings. They had had a fair share of the Government orders for small arms, ammunition, and their supplies had been up to the mark. With respect to the De Laval steam turbine business, the manufacture of the component parts of those machines had been steadily taken in hand during the year, and they were now in a position to produce all sizes and varieties at their Leeds works, and were deriving the benefit of the manufacturing profit thereon. It was well known and acknowledged that the principle of the steam turbine was rapidly gaining favour as it offered such great advantages over the ordinary steam engine. The De Laval was in quite an exceptional manner adapted for the direct driving of dynamos, pumps and fans, in connection with which a good and profitable business had already been initiated. They had received most satisfactory reports of the installations recently erected, and what was better, a good number of repeat orders had been received in consequence. Without desiring to be in any way over sanguine, the directors felt quite as hopeful as ever that this turbine business would fully realise, eventually, the expectations formed when it was entered into. As stated in last year's report, the board decided to take additional shares in the English De Laval Steam Turbine Co., Ltd., to represent the greater part of the money expended by the company in developing that branch, and which figured in last year's balance-sheet at £26,309 7s. 11d. Their holding in the company was now represented by 3,004 shares of £10 each, but as they had devoted the profits they had derived from the sole selling agency of those machines to writing down the value of the shares, those now stood in their books at £21,674 1s. only. They would see from the balance-sheet that they had written off £5,000 depreciation of plant, and placed £5,000 to writing down book value of investments. This latter was considered desirable with regard to the shares they held in the Russian Engineering Co., in consideration of the depressed state of trade in Russia. Their holding in that company now stood at only a nominal sum. They had expended during the year £4,735 0s. 9d. on maintenance account out of revenue, and £13,913 7s. 8d. on additions to buildings and plant, part of that sum being for the completion of the electrical equipment of the works. Their stocks were £8,000 more than last year, and that was accounted for by the greater bulk and amount of orders on hand. In conclusion, he asked the sanction of the shareholders for a donation of £500 in aid of the funds for the new University of Leeds. The Yorkshire College, now merged in the University, had, he said, been good customers to the company for electric motors and other work, and they had been greatly indebted to the College for information and assistance.

The motion was seconded by Lieut.-Colonel RALPH VIVIAN, and carried, and the donation to the University was agreed to.

Edmundson's Electricity Corporation.

THE report of the directors and statement of accounts for the year ended March 31st, 1904, to be presented at the seventh annual meeting of the corporation at the Westminster Palace Hotel on Thursday next, 21st inst., at 12 o'clock, states that, including the sum of £11,733 6s. 4d. brought forward from last year, the net profit, after payment of debenture and other interest, amounts to £64,405 18s. 3d. After deducting dividends on preference shares paid and accrued, amounting to £15,544 12s. 8d., and an interim dividend at the rate of 5 per cent. per annum on the ordinary shares amounting to £8,750, there remains a balance of £40,111 5s. 7d., which the directors recommend should be appropriated as follows:—

To a final dividend on the 70,000 ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year	£15,750	0	0
To be written off goodwill account	5,000	0	0
To be added to reserve fund	5,437	14	4
Leaving to be carried forward to next account	13,923	11	3
	£40,111	5	7

The following central stations have been erected and opened since the last report:—On account of local authorities, at Surbiton, Frome and Dorking; on account of the Urban Electric Supply Co., Ltd., at Caterham, Glossop and Berwick; on account of the Isle of Wight Electric Light and Power Co., Ltd., at Ryde. During the year 20,000 preference shares, 20,000 ordinary shares, and £92,196 debenture stock have been issued. The premiums received in respect of these issues, less expenses, amount to £24,562 5s. 8d., and have been added to the reserve fund, which, with the contribution proposed to be made from revenue account, will be thereby increased to £70,000. The large increase in the capital this year has been necessary for the completion of central stations in new towns, and large extensions to many of the older works, and this additional capital will bear fruit in due course in the form of increased revenue. The necessity for such expenditure is shown by the very large increase in the lamp connections, which have risen from 335,569 on March 31st, 1903, to 568,549 on the same date this

year. The only towns for which the company possesses statutory powers, and which have not yet been dealt with are Ramsgate and Inverness. The capital expenditure in the future will be on a much smaller scale, as it is not the intention of the directors to seek further powers, the company having ample scope in the development of the undertakings in which it is already interested. The directors regret to announce the resignation, on account of ill health, of their chairman, Mr. J. R. Wigham. They have elected Mr. H. Wolfenden to the vacant directorship.

Pearson Fire Alarm.

The first annual general meeting of this company was held on Tuesday last at Cannon Street Hotel, the chairman, Mr. W. Chamberlain, presiding.

The Chairman referred to the hard work of the past year, and expressed his unabated confidence in the value of the company's system. They were burdened with an unproductive expenditure of £88,238, but had a balance in hand of £30,928 available for further developments. The factory had been removed to Shoreditch; it was well equipped, and was doing good work. As all the directors of the company had been directors of the Central Insurance Co. also, Sir J. Cockburn and Mr. Crawley resigned, and Messrs. J. H. Hartridge and Andrew Williamson, who had no connection with the Central Insurance Co., were appointed. Great difficulty had been met with in inducing public authorities, who had many human lives under their care, to adopt automatic fire alarms, in spite of the disastrous fires which had occurred. He did not fear fair competition, but welcomed it as helping to advertise the fire alarm business.

The report and accounts were unanimously adopted, and the new directors, who were also the retiring directors, were re-elected. The auditors, Messrs. Saffery, Sons & Co., were also reappointed.

The Direct United States Cable Co.—The directors have resolved to recommend a final dividend of 3s. per share (free of income-tax), such dividend to be payable on and after the 30th inst., making with the three interim dividends already paid, a total distribution of 3 per cent. for the year ended June 30th last, and after placing £6,000 to reserve fund account, carrying forward a balance of about £2,168. The transfer books of the company will be closed from July 12th to the 26th, both days inclusive.

British Columbia Electric Railway.—This company's transfer registers of 5 per cent. cumulative perpetual preference shares will be closed from July 8th to July 15th, inclusive, for preparation of dividend warrants.

Electric Supply Corporation.—The list of subscriptions for the issue of 46,600 ordinary shares of £5 each at par by the Electric Supply Corporation, Ltd., will close to-day.

St. James's and Pall Mall Electric Light Co.—The share transfer books of this company will be closed from the 16th to the 30th inst. inclusive, preparatory to the payment of interim dividends.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in, and to grant a quotation to:—London United Tramways (1901), Ltd.—Further issue of 25,000 5 per cent. cumulative preference shares of £10 each, fully paid. The Committee has also been asked to appoint a special settling day in:—Marconi's Wireless Telegraph Co., Ltd.—Further issue of 25,000 shares of £1 each, fully paid, Nos. 196,128 to 221,127.

STOCKS AND SHARES.

Wednesday Evening.

To write an article upon stocks and shares in these dog-days of dullness is to acquire the touch of nature which makes one strongly sympathise with the Israelites of old, who toiled at making bricks without straw under the weltering sky of Egypt. In our accompanying price-lists the number of changes amounts to less than a dozen—a fitting commentary upon the idleness of business. It must be observed, however, that electrical shares are not wholly languid, such lines as 500 Westminsters changing hands at quoted prices without altering the latter to any extent, which, in its way, is a satisfactory earnest of the sound character of the market devoted to these investments. Some say that the public have become so sickened of all that pertains to the Stock Exchange by the recent display made in various witness-boxes by certain financiers, that they will for ever eschew share-dealings in future. We merely mention the prophecy as an example of how far some people can be affected by a heat-wave.

Home Railway stocks, now upon the eve of dividend announcements, are little moved by the market estimates-in-advance. Our tables show that none of the electrical railway stocks have changed since last week, although the tone in City and South London Ordinary is rather better. The company's dividend should be out by the time these notes appear, but it may be mentioned that the estimate in the Stock Exchange puts the distribution at a probable 1¼ to 1⅜ per cent. This time last year the rate was 1⅜ per cent. Central Londons continue to mark time. The Waterloo and City dividend should also be out very shortly, and it will compare with the 3½ per cent. which created such a favourable impression for the first half of 1903, but which the results of the final six months failed to maintain.

Metropolitans at 96½ are only fairly firm, and there is a "tip" out to sell the stock. We don't believe in these vague generalities as a rule, but perhaps a reaction is not unlikely after the recent rapid rise in Metropolitan Consolidated. Districts are 38, Great Northern and City Preferred "A" shares have again weakened to 4¼, and the Underground Electric Profit-Sharing Notes remain at 97.

Optimism-cum-caution was the key note of the chairman's speech at the British Electric Traction meeting, but it has not stayed a further fall of 5s. in the price of the Ordinary. The shares should be *ex* dividend to-morrow, Thursday, and perhaps the deduction may cause the price to look temptingly low. From what we can gather unofficially, the company has about enough money to last it for a year, within which period financial conditions may, of course, recover sufficient elasticity for the British Electric Traction to launch some of its subsidiaries, and thereby obtain capital for developing its business. The company's 5 per cent. Debenture stock has gained a point at 117½, and the Second Debenture is 96½.

Other Traction descriptions are good. Anglo-Argentine Tramway Debenture has risen to 139, and City of Buenos Ayres Debenture is 142½, the shares of the last-named being the round 10. London United Tramways Preference are ¼ lower at 10¾, but the Debenture keeps about 103. We have heard nothing of a new issue. Auckland Electric Tramway 5 per cent. Debenture is still being absorbed for investment, and the stock changes hands at a fraction over 99. The Metropolitan Electric Tramway Debenture stock will have its special settlement next Wednesday, July 20th, and the nominal price is now 97 to 98.

After being 22, as we mentioned last week, Metropolitan Electric Supply shares have sobered down to 21½, a rise of 10s. The directors' decision to distribute a bonus of £6 a share is regarded with satisfaction on the whole, although we have heard some of the proprietors half-regretting that the board did not keep more in hand with which to embark upon a policy of wide extension. Possibly these shareholders will change their minds when they hear what their stewards have to say at the forthcoming meeting. Mr. George Kitchin's resolution for acknowledging the directors' services is a well-earned tribute.

The St. James's Co. has declared its regular interim dividend, and several of the others are expected to follow suit within the next few days. Blackheath and Greenwich shares will soon be known no longer under that title, unless the shareholders decline to change the name of the undertaking to that of the South Metropolitan Electric Light and Power Co. With reference to the new issues of Preference shares and Debenture stock, we hear that both are being well supported by the present proprietors, and some surprise is permissible as to why the expense of underwriting was incurred at all. London Electric Debenture at 95½ has improved a point, and Edmundson's Debenture is again somewhat harder. The Edmundson's Co. has declared a final dividend at the rate of 9 per cent. per annum, and the Preference thereupon rose 5s.

Amongst Telegraph varieties, the only quotable change of general interest is ¼ rise in Eastern Extensions, making the price 12¼. This brings the price more into line with that of Eastern Telegraph Ordinary stock, and the Russo-Japanese war is thought to be throwing additional traffic on to the cables of both companies. Other Telegraph stocks are motionless, but the National Telephone group improved, the Preferred and Deferred rising to 107 and 90½ respectively upon the dividend announcements and the Telephone Conference. The Third Preference at 5½ has risen 2s. 6d., and Chili Telephones are ¼ up at the same price. We hear quietly that the National Telephone Co.'s negotiations with the Post Office are going in favour of the former.

Cromptons at 2 are no better on the Electric Supply Corporation prospectus, but it is a curious coincidence that Electric Constructions should be another ¼ lower at 1¼ this week. Again that poor report. Willans & Robinson Ordinary slipped back to 2½, and the Preference are 3½; there is no change to record in Babcock & Wilcox, but Henley's at 11 are ½ easier.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations July 6th.	Closing Quotations July 13th.	Business done week ended July 13th, 1904. Highest	Lowest
£7,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101 xd	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3¼	2¼— 3¼	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	.. ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	46 — 49	46 — 49	47½	46½
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	91 — 93	92½	91½
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	6¼— 7	6¼— 7	6 13/16	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	4½— 5½	5 — 5½	..	..
12,388,300$	Commercial Cable	$100	8 %	8 %	..	170 —190 xd	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 95 xd	93 — 95	93½	..
16,000	Cuba Telegraph	10	4 %	6½%	5 %	6¼— 7½	6¼— 7½	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
12,931	Direct Spanish Telegraph	..	..	..	..	.. — ..	.. — ..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101%xd	98 —101	..	..
60,710£	Direct United States Cable	20	8½%	8½%	8 %	10 — 10⅝	10 — 10⅝	10 5/16	10⅛
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	99 —101 xd	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	126 —131	126 —131	130⅜	128½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	89½	87½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	105	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11¾— 12¼	11¾— 12¼	12 5/16	12
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	100⅛	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 3,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	8⅜— 9½	8¾— 9½	8 1/16	8⅜
180,042	Do. do. 6 % Pref.	10	..	..	..	13 — 13½	13 — 13½	13⅛	13¼
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	25½— 26½	25½— 26½	25⅝	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	42 — 45	42 — 45	..	..
1,968,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —106	106 —108	105⅛	104⅞
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	87 — 90	89 — 92	89⅞	88
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	12 5/16	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5½	5⅛— 5⅜	5 1/16	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99 xd	97 — 99	97⅜	97½
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105 xd	103 —105	103½	..
1,000,000	Do. do. Prov. Certs., 70 % to be paid	..	..	..	..	29 — 31	29 — 31	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,604, fully paid	1	6 %	6 %	6¼%	1 5/16— 1 7/16	1 5/16— 1 7/16	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100 xd	97 —100	..	..
11,889	Reuter's	8	5 %	..	..	6½— 7½	6½— 7½	..	..
3,808	Submarine Cables Trust	Certs.	..	..	..	118 —123	118 —123	121	120½
58,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6½	6 — 6⅞	6 5/16	6 1/16
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¾— 5¼xd	4¾— 5¼ xd	5 1/16	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brax. Sub. Tel.	100	..	..	..	95 — 98 xd	97 —100	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	12½— 13 xd	12½— 13	12 13/16	12⅝
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104 xd	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	99 —102 xd	99 —102	..	..
88,321	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6¼— 6¾	6¼— 6¾	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102 xd	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

90,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	92 — 97	92 — 97	92½	..
100,000	British Electric Traction	10	9 %	8 %	..	9½— 9¾	8¾— 9¼	9⅜	9
100,000	Do. do. 6 % Cum. Pref.	£10	..	..	..	10½— 11	10½— 11	11	10¾
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	115 —118	116 —119	..	..
100,000	British Insulated and Helsby Cables	£5	10 %	10 %	8 %	5⅞— 6⅛	5⅞— 6⅛	6 1/16	..
100,000	Do. do. 6 % Cum. Pref.	£5	..	..	..	6⅛— 6⅜	6⅛— 6⅜	..	..
60,000	Do. do. 4½ % 1st Mort. Deb. Red.	£100	..	..	..	101 —104 xd	101 —104	..	..
60,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅞— 1	⅞— 1	..	..
60,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	¼— 1	¼— 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	¾— 1½	¾— 1½	15/16	29/32
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	71 — 76 xd	71 — 76	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9¼— 10¼	9¼— 10¼	..	..
40,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5¼ xd	5¼— 5¼	5⅛	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	102 —106 xd	102 —106	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	90 — 93	90 — 93	92½	91
494,093	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	102 —105	102 —105	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	79 — 82	79 — 82	..	..
1,320,000	City and South London Railway	Stock	2 %	3½%	2⅔%	47 — 49	47 — 49	48⅜	48⅛
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1⅞— 2¼	1⅞— 2¼	1⅞	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	93 — 96 xd	95 — 98	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	£5	Nil	Nil	..	⅜— ⅝	⅜— ⅝	..	..
17,189	Do. do. "A" shares, 01—017,189	£5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	74 — 79 xd	76 — 81	80	..
100,000£	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 79	75 — 79	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	4¾%	1½— 1¾	1½— 1⅝	1 3/16	..
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	2	..	..	..	2¼— 2⅝	2¼— 2½	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9¼ xd	9 — 9¼	9 1/16	9 1/16
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11¼— 12⅛	11 — 12	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,400	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½ — 19½ xd	18¾— 19½	..	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3¾— 4	3¾— 4	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	36 — 39	36 — 39	38½	37⅝
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	99 —102 xd	99 —102	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	89 — 92	89 — 92	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES

Present Issue.	NAME,	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations July 6th.	Closing Quotations June 13th.	Business done week ended July 13th, 1904. Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡							
50,000	Do. 7 % Pref.	1	..	..	..	5/16 — 7/16	5/16 — 7/16	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	1	..	..	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	100	..	..	..	122 —127	122 —127	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	8 %	8 %	10 %	10 3/8 — 11 1/8	10 3/8 — 11 1/8	11 1/16	11
250,000	Central Electric Supply 4 % Guar. Deb. Stock	5	..	..	..	10 1/4 — 10 3/8	10 1/4 — 10 3/8	..	..
50,000	Charing Cross and Strand Electricity Supply	100	..	..	..	105 —108	105 —108	..	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	10 %	10 %	8 %	7 1/2 — 8	7 1/2 — 8	7 13/16	7 1/2
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	5 1/8 — 5 3/8	5 1/4 — 5 3/8	5 5/16	5 1/8
40,000	Do. do. 1903	5	..	..	..	4 3/8 — 5 xd	4 3/8 — 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	5	..	..	..	4 3/8 — 5 xd	4 3/8 — 5	4 3/8	..
44,436	*Chelsea Electricity Supply, Ord.	100	..	..	..	102 —104	102 —104	..	..
150,000‡	Do. do. % Deb. Stock Red.	5	4 %	4½%	5¼%	6 1/2 — 6 3/4	6 1/2 — 6 3/4	6 5/8	6 1/2
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	Stock	..	..	..	106 —109 xd	106 —109	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	5 %	5 %	5 %	11 — 11 1/2	11— 11 1/4	18 3/8	18 1/2
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	10	..	..	..	18 — 14	13 — 14	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	..	..	..	..	102 —105 xd	120 —125	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	100	..	..	..	101 —104 xd	101 —104	103½	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000. .	10	4 %	4 %	4 %	7 1/2 — 8 1/2	7 1/2 — 8 1/2	..	..
400,000‡	Do. do. 4½% Deb. Stock	10	..	..	..	11 — 12	11 — 12	11 3/8	11
250,000	Do. do. 4½% 2nd Deb. Stock	..	..	..	..	104 —107 xd	104 —107	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	Stock	..	..	..	100 —103	100 —103	101 1/2	..
30,000	Do. do. 6 % Cum. Pref.	5	7 %	7 %	7 %	5 3/4 — 6 1/8	5 3/4 — 6 1/8	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	..	..	..	..	5 3/8 — 5 3/4	5 3/8 — 6	5 3/8	..
21,000	Kensington and Knightsbridge Electric Ord.	100	..	..	..	107 —109	107 —110	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	5	10 %	10 %	12½%	12 — 13	12 — 13	12 3/8	..
110,000	London Electric Supply Corporation, Limited, Ord.	Stock	..	..	..	102 —105	103 —105	..	..
49,840	Do. do. do. 6 % Pref.	8	..	..	..	1 1/2 — 1 3/4	1 1/2 — 1 3/4	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	5	..	..	..	4 1/2 — 5 1/2	4 1/2 — 5 1/2	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	Stock	..	..	..	94 — 96	94 — 97	..	..
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	10	6¼%	7½%	8¾%	20½ — 21½	21 — 22	21 7/8	21 3/4
250,000‡	Do. do. 4½% 1st Mort. Deb. Stock	5	..	..	..	5 1/4 — 5 3/8 xd	5 1/4 — 5 1/2	5 5/16	5 5/16
250,000‡	Do. do. 5½% Mort. Deb. Stock Red	..	..	..	..	108 —112 xd	108 —112	..	..
10,852	Notting Hill Electric Lighting	Stock	..	..	..	96 — 99 xd	96 — 99	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	10	6 %	6 %	6 %	13 — 14 xd	13 — 14	13½	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	14¼%	14½%	14¾%	14½ — 15½	14½ — 15½	15	..
150,000‡	Do. do. do. 8½% Deb. Stock Red ..	5	..	..	..	8 — 9	8 — 9	..	..
12,000	Smithfield Markets Electric Supply, Ord.	100	..	..	..	96 — 99 xd	96 — 99	..	..
50,000	Do. do. do. 4 % Deb. Stock	5	..	2½%	4 %	2 3/4 — 3 1/2	2 3/4 — 3 1/2	..	..
65,000	South London Electricity Supply, Ord.	Stock	..	..	..	85 — 90	85 — 90	..	..
80,000	Urban Electric Supply, Ord.	5	..	1½%	3 %	3 3/4 — 4 1/2	3 3/4 — 4 1/2	4 1/8	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4 1/2 — 5	4 1/2 — 5	..	..
110,000	Westminster Electric Supply, Ord.	5	..	..	..	4 1/2 — 5	4 1/2 — 5	4 3/4	..
28,141	Do. do. 5 % Cum. Pref.	5	10½%	12 %	13½%	12 1/4 — 13 1/4	12 1/4 — 13 1/4	13 1/8	12 1/8
		5	..	..	..	6 1/4 — 6 3/4	6 1/4 — 6 3/4	..	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS. Wednesday, July 13th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£21 10	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	6d.	..
a ,, Caustic (75/80%).. ..	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	200/-	20/- dec.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£8	..
a ,, Bichromate, casks.. ..	per lb.	2½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£180	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£48 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¼d.	..
c ,, Tube (brazed)	per lb.	8¼d.	..
c ,, ,, (solid drawn).. ..	per lb.	7¼d.	..
c ,, Wire, basis..	per lb.	6¾d.	..
c Copper Tubes (brazed)	per lb.	9¼d.	..
c ,, ,, (solid drawn) ..	per lb.	9¼d.	..
Copper Bars (best selected)	per ton	£70	£1 inc.

METALS, &c. (continued).		Latest Price.	Week's Dec. or Inc.
g Copper Sheet	per ton	£70	£1 inc.
g ,, Rod	per ton	£70	£1 inc.
e ,, (Electrolytic) Bars ..	per ton	£62	..
e ,, ,, Sheets ..	per ton	£78	..
e ,, ,, Rod ..	per ton	£72	..
e ,, ,, H.C. Wire	per lb.	7¾d.	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/9½ to 4/10½	inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	42/6	..
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 17 6	2/6 dec.
g ,, ,, Sheet	per ton	£11 17s. 6d.	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 17 6	2/6 dec.
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/- to 1/8	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	£4	..
c Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£121 to £122	£2 inc.
g ,, Foil	per lb.	1/6	..
m ,, Wire, Nos. 1 to 16	per lb.	1/6½	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5½d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4 1/2d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh's (Vieille Montagne brd.)	per ton	£24 15	..

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co., f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Aberdeen	July 2	1,417	+ 60	5	7,468	+ 1,217	10	—
Birmingham ..	,, 9	5,798	+661	28	150,003	+ 9,444	32½	—
Blackburn	,, 8	993	+115	15	14,363	+ 1,110	13½	—
Blackpool	,, 7	1,149	+ 58	14	12,550	+ 665	8½	—
,, —Fleetw'd	,, 9	870	+ 59	2	1,136	— 184	7½	—
,, —Lytham	,, 7	540	+ 27	26	9,803	+ 5,767	7½	—
Bolton	,, 10	2,151	+137	15	27,874	— 47	25	—
Bournemouth ..	,, 6	1,052	— 6	14	15,358	—	10½	—
Bradford	,, 2	4,694	+493	13	60,995	+10,216	50	—
Brighton	,, 11	1,188	+206	—	13,854	—	8	—
Bristol	,, 8	5,483	+346	—	—	—	28	—
Devonport ..	,, 1	574	+ 59	26	13,224	+ 2,139	5	—
Dudley—Sto'rb'ge	,, 1	909	— 83	26	21,325	+ 687	18½	—
Gateshead ..	,, 1	855	— 5	26	23,144	+ 1,054	10½	+ ½
Gr'n'k—Pt. Glsgw	,, 1	638	— 52	26	13,809	+ 579	7½	—
Oldham—Ashton	,, 1	576	— 56	26	13,805	— 805	5	—
Potteries	,, 1	1,869	— 14	26	43,865	+ 3,450	28½	—
Southport	,, 1	408	+ 46	26	7,816	+ 434	5½	—
South Staffs. ..	,, 1	705	—330	26	20,132	— 1,499	21½	—½
Swansea	,, 1	590	— 4	26	13,308	+ 797	5½	—
Wolverhampton..	,, 1	433	—	26	9,784	— 203	10½	+8
Yorks. Wool Dist.	,, 1	622	+197	26	14,964	+ 6,419	6	—
Miscellaneous ..	,, 1	3,824	—	26	75,102	—	—	—
Burnley	,, 9	1,024	+172	—	—	—	10½	+3½
Burton-on-Trent ..	,, 10	327	—	14½	5,000	—	8½	—
Cardiff	,, 2	2,179	+ 53	13	27,432	+ 1,038	14	—
Chatham & District	,, 7	701	+ 89	27	15,233	+ 2,027	9·53	—
Cork	,, 7	611	— 76	27	11,993	— 986	9	—
Dover	June 25	252	— 16	25	4,813	— 259	3	—

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Dublin	July 8	5,331	—245	—	6,057	— 247	47	+ ½
East Ham	,, 9	773	+ 90	14	11,033	+ 1,004	5	+ ½
Glasgow	,, 9	13,794	+ 750	6	83,459	+ 489	71½	+6½
Halifax (2 weeks) ..	June 29	3,214	+ 74	13	19,512	+ 1,147	33	+1½
Huddersfield ..	July 9	1,404	+137	14	—	—	28	—
Hull	,, 9	2,181	+300	14	30,600	+ 3,576	13	+2½
Ilkeston	,, 6	142	— 50	14	2,060	—	8	—
Ipswich	,, 9	564	—	14	7,072	—	10½	—
Isle of Thanet ..	,, 9	1,124	— 51	27	12,312	— 371	10½	—
Leeds	,, 9	6,131	+590	—	87,708	+ 5,100	81½	+2
Liverpool	,, 2	11,348	+ 222	27	270,355	+ 5,807	104	—
London C. C. ..	,, 2	13,829	+1835	13	156,931	+26.152	39½	—
Manchester	,, 9	13,216	+1007	14	173,035	+ 4,709	131½	—
Newcastle	,, 9	3,512	+304	—	—	—	17	—
Portsmouth	,, 2	2,220	+ 37	—	26,180	+ 2,207	14½	—
Salford	,, 4	4,197	+197	—	55,824	+ 4,695	30	—
Sheffield	,, 10	4,924	+185	15	71,484	+ 2,093	33	+5½
Southampton ..	,, 7	892	—229	—	—	—	9	—
Southend-on-Sea ..	,, 6	435	+ 36	14	4,648	+ 317	6½	—
Sunderland	June 26	1,361	— 44	12	15,630	+ 348	20	+1
Tyneside	July 6	881	+ 67	27	9,383	+ 1,784	8·9	+ ·4
West Ham	,, 7	1,106	—	19	14,330	—	8	—
Wolverhampton ..	,, 6	731	+254	—	—	—	9·5	—
Cen. London Rly. ..	,, 11	6,414	—510	1	—	—	6	—
City & S. Lon. Rly.	,, 10	2,336	—187	2	4,847	— 81	6½	—
Dublin—Lucan Rly.	,, 8	161	+ 67	1	161	+ 67	6½	—
G. N. and City Ry.	,, 9	968	+ 39	21	10,429	—	3½	—
L'pool Overh'd Rly.	,, 10	1,672	— 46	2	3,361	— 29	6½	+½
Mersey Railway ..	,, 9	1 429	+ 37	1	—	—	4½	—

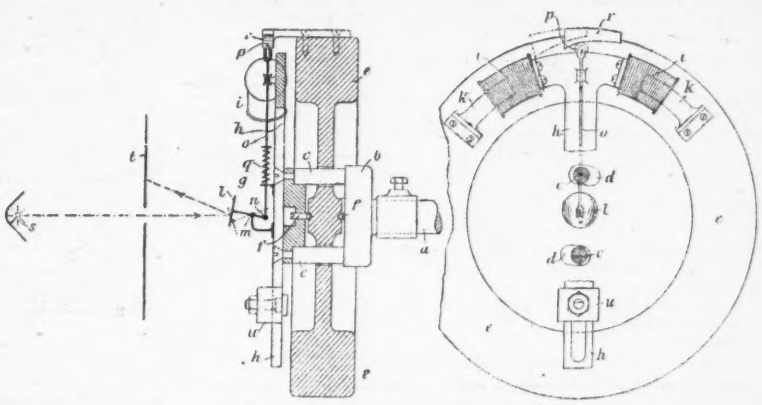
* Compared with the corresponding period of 1903.

MEASURING THE IRREGULARITY IN SPEED OF ENGINES.

Of all apparatus designed hitherto for measuring the irregularity in the speed of engines, or for making visible such irregularity, a precision has been expected which has not generally been realised. It is also often demanded that the irregularity of the machine tested be directly and continuously indicated by the apparatus. It is not possible to construct such apparatus with any great degree of accuracy, but it is, on the other hand, desirable that the irregularity of running should be at least approximately ascertained, and, if possible, that the fluctuations of speed should be rendered visible throughout the revolution.

It is customary to calculate the maximum irregularity from theoretical considerations, and to adjust the design of an engine in accordance therewith, in order to conform with specifications; and, therefore, it is of importance to know whether the design does, in fact, conduce to the uniform running of the set. The apparatus herein described, the invention of Dr. P. Berkitz, allows the irregularity of running to be observed and recorded, and resembles in its purpose the indicator universally used for steam engines.

The apparatus, which is patented, is based on the following principle: A uniform motion is kept up by a heavy disk, acting as a fly-wheel, and the relative motion between this and the fly-wheel of the machine is transmitted by a suitable mechanical arrangement to a mirror, which reflects a beam of light on to a stationary screen. The beam of light describes a distorted circle on the screen, and the degree of distortion is a measure of the irregularity in speed of the engine fly-wheel. With reference to the adjoining figure, *a* is the engine shaft upon which a disk, *b*, is fastened, the two arms, *c c*, of which pass freely through holes, *d d*, in the fly-wheel, *e*. The latter is supported frictionless on pins, *f*. One of these pins is fixed to *b*, the other to a plate, *g*, the latter being carried by the arms, *c*. To plate *g* is attached the arm *h*. At starting, the fly-wheel, *e*, is set in motion by the arms, *c*, but afterwards it continues its motion at a uniform speed, an additional controlling moment to overcome air resistance being imparted to it electrically. For this purpose the arm, *h*, is provided with two electro-magnets, *i i*, the exciting current for which is conducted to them by means of slip rings. The electro-magnets exert a certain pull on the iron cores, *k k*, fixed to the fly-wheel, and this pull may be regulated by adjusting the exciting current. The mirror, *l*, is fixed in line with the axis, and is free to turn round the pivot, *m*. One end of the rod, *o*, is attached to the lever, *n*, while its other end carries the wheel, *p*. A spring, *q*, presses *p* against the curved piece, *r*, which is fixed to the periphery of the fly-wheel, *e*. It is now clear that any relative motion of the fly-wheel, *e*, with regard to the engine shaft will cause the mirror, *l*, to be deflected. In doing so, the beam of light emanating from *s* will be thrown under a new angle upon the screen, *t*. If the screen be of sensitive paper, then a permanent record may be obtained. A counterweight, *u*, is provided for balancing the electro-magnets, &c.



Apparatus for Measuring Irregularity in Speed.

THE MUNICIPAL ELECTRICAL CONVENTION.

POLYPHASE SUB-STATIONS: THEIR EQUIPMENT AND WORKING.

By S. L. Pearce, Chief Electrical Engineer, Manchester.

(*Abstract of paper read at Nottingham, June 30th.*)

The supply of electrical energy over very largely extended areas, either for traction or lighting purposes, or both, has necessitated the introduction of polyphase systems of generation, transmission at high voltages, and the distribution from corresponding sub-stations of low voltage direct or polyphase currents. The sub-station and its equipment is, therefore, one of the most important factors in connection with such a system, and on its suitability success will largely depend.

There are several considerations which will determine the particular type of equipment to be employed, especially (*a*) Traction or lighting requirements; (*b*) Frequency of the system; (*c*) Two *v.* three-phase. Some equipments are more suitable for the ever-varying loads and over-loads met with in traction work than for the steady lighting loads, where a constant pressure is of prime importance.

As the frequency of a system has such an important bearing on the capital cost, it is desirable, wherever possible, that this should be kept high, say from 40 to 50 cycles, otherwise the main generators, transformers, and motors will become much heavier, and, therefore, more expensive, and at this frequency "mixed" systems can be conveniently operated.

The third consideration, viz., the question of two-phase *v.* three-phase, will be decided on for reasons apart from those connected with the sub-station. The relative cost and efficiency of generating plant and transmission lines for two or three-phase will have to be taken into account. It may fairly be stated that three-phase generators are cheaper to build and lighter than two-phase, whilst their efficiency is equally good, if not better. The transmission cables are simpler, as also are the switching devices. Theoretically also, at any rate, a greater power can be transmitted in a three-phase system with a given weight of copper than on a two-phase system. As far as the machinery at the sub-station is concerned, there is little to choose between two and three-phase where efficiencies and cost are concerned. Taking these various points into consideration, there is little doubt that three-phase is to be preferred. The equipment to be considered in this paper will be of the three-phase type, with terminal voltages of from 5,000 to 10,000.

Rotary Converters.—The outstanding advantages to be obtained from the use of this class of converter are low prime cost, high efficiency, ability to stand overload limited only by the temperature rise, small floor space for a given output, and the high power factor which can be maintained over the system. On the other hand, there is a certain want of stability which manifests itself in sensitiveness to variations in the line voltage, causing difficulty in parallel running, and a tendency to hunt and get out of step. This want of stability is more noticeable in rotaries built with laminated steel poles than in those with solid pole-pieces. The regulation also is not as flexible as in other systems, and switchgear and switching operations become somewhat complicated, but for purely traction schemes, their high efficiency, and ability to stand very considerable over-loads, are factors of great importance which more than outweigh the disadvantages named. Although the six-phase connection for rotaries is complicated, there is a considerable economy to be gained in the use of it—a fact which is being recognised in the latest installations in this country. The heating of the armature is more uniform, and there is consequently a considerable gain in the output, since this depends on the temperature rise. The step-down transformers may be connected up either "star" or "mesh." The advantage of the latter method lies in the fact that should one transformer be put out of circuit through any cause, the supply will not be interrupted; the remaining transformers will still maintain a three-phase supply to the converter, which can be run at its full load as long as the heating in the two remaining transformers does not become excessive. "Star" connected transformers are cheaper in first cost, since the pressure between the centre point of the star and the ends of either transformer is proportionally less than the line voltage. For lighting schemes with distribution on the three-wire or three-phase system, there is a distinct advantage to be gained by the "star" connection, since the centre point can be connected to the middle or neutral conductor for balancing purposes. Rotaries should be operated at low frequencies of 25 to 30 cycles per second to attain the best results. This guarantees the more stable operation of the machines, and permits a wider range of compounding than is obtainable with higher frequencies. Where rotaries are being operated at 40 to 50 cycles, it would appear desirable to have connected on the same system a proportion of induction motors which would tend to act as "electric dashpots" in the system, and thus help to make the rotary converters more stable than they would be in a system having nothing but rotaries.

Synchronous Motor-Generators.—In this type of equipment no intermediate transformers are necessary, as the line pressure is brought straight on to the terminals of the stator of the motor. The merits of this system, in which higher frequencies can be employed, are simplicity of operation, flexibility, high power factor in working, and the fact that the regulation of the direct current pressure is independent of the alternating current voltage.

As compared with rotaries, they are some 3 to 4 per cent. less efficient, and their ability to stand over-loads is determined by the over-load capacity of the generator. For lighting and "mixed" systems the synchronous motor-generator has much to commend it on the ground of stability, satisfactory parallel running, and ease of regulation.

Non-Synchronous Motor-Generators.—This equipment differs from the former only in the employment of non-synchronous motors in

place of synchronous motors, and is the simplest type of sub-station plant that could be devised. The high pressure currents in this case also are led either through choking coils or direct to the motor, and the starting up is accomplished from the high tension side. Consequently no complicated switchgear is required, and synchronising is obviated. As with synchronous equipments, the regulation on the D.C. side is independent of the A.C. The great drawback to non-synchronous motors is the comparatively low power factor at which they work. For mechanical reasons, the width of the air-gap in induction motors is considerable, more particularly with small units, and it is advisable to watch this closely, with a view to keeping it equal at top and bottom of the rotors. In order to avoid heavy lagging currents on the system, the motors should be run well up to their full load. Lagging currents not only waste energy, but pressure regulation becomes exceedingly difficult, owing to their demagnetising effects. In every sub-station means must be provided for starting up from the A.C. side in the event of low-tension D.C. not being available. For this purpose the motor-generator with an induction motor is especially useful, owing to the rapidity with which it can be started to enable a supply of direct current to be obtained for starting up the synchronous sets. If the latter be run with their fields "stiffened," or slightly over-excited, the heavy lagging currents of the induction motor may in some measure be compensated for, and the power factor of the system thereby improved.

A modification of the ordinary induction motor-generator has recently been brought forward by one firm in this country under the name of "motor-converter." This combination consists of a D.C. generator coupled to an induction motor—the two machines being electrically as well as mechanically interconnected; H.T. currents at 50 periods circulate in the stator windings of the induction motor. Owing to the back E.M.F. of the D.C. machine, the speed of the rotor, however, corresponds to half synchronism only. Currents are therefore generated in the rotor windings at a periodicity of 25, and these currents pass into the D.C. armature, by suitable cross connections, and are there commutated. Theoretically half the power of the combination is transmitted through the shaft, and the remaining half through the electrical cross connections. In the first case the D.C. machine acts as a generator; in the latter case the motor acts as a transformer, and the D.C. machine as a generator. To a certain extent, therefore, this machine appears to combine the advantages possessed by both motor-generators and rotary converters, and the practical results obtained therefrom will be of considerable interest.

The following table shows the relative cost, efficiency, floor space, and power factor of various sizes of the three classes of equipment:—

VOLTAGE 6,500. FREQUENCY 50.

—	Asynchronous motor-generators.	Synchronous motor-generators.	Rotaries.
Output	220 KW.	220 KW.	220 KW.
Costs	£6·1 per KW.	£5·5 per KW.	£3·8 per KW.
Efficiency (full load)	86 per cent.	89 per cent.	92 per cent.
Floor space...	12 ft. 3 in. 8 ft. 5 in. approx.	12 ft. 3 in. 8 ft. 5 in. approx.	7 ft. 7 ft. approx.
Power factor (full load)	92 per cent.	Unity.	Unity.

Fig. 1 comprises three curves showing the approximate relative costs of three types of sub-station equipment.

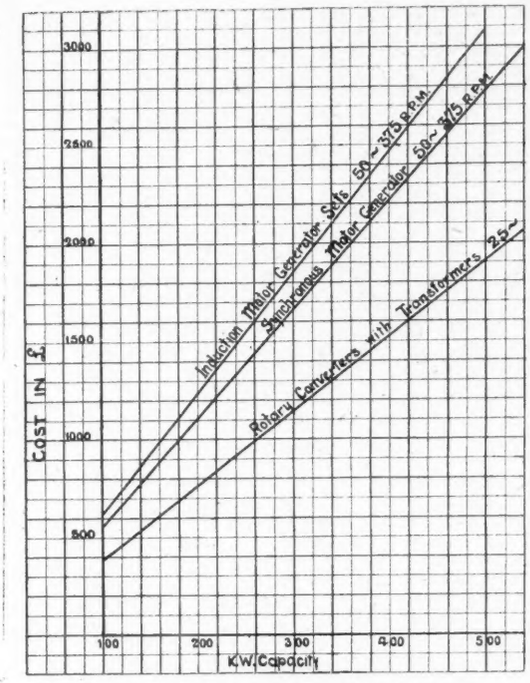
Static Transformers.—The distribution of polyphase currents at low pressure is undoubtedly coming to the front. A sub-station has recently been put down in Manchester for the supply of three-phase current at 200 volts to some extensive locomotive works, where it is expected that the ultimate demand will be approximately 700 KW.

When one considers the increased capital involved in respect of plant and buildings for sub-stations equipped with rotaries or motor-generators, the increased labour costs for running and maintenance, and the moderate all-day efficiencies obtained, it would appear that the polyphase system of distribution for mixed "lighting and power schemes" has much to recommend it.

The transformation of polyphase currents is frequently carried out by the use of three single-phase transformers, which may be connected up either "mesh" or "star" fashion. The advantage of using three-phase transformers is a saving in copper and iron, resulting in a lower first cost; further, their common magnetic circuit tends to reduce any variation in the pressure between the phases, and for this reason they are preferable for use on lighting circuits.

The great advantage in using the single transformer type is that breakdown risks are minimised, and a smaller amount of spare plant is required. These points largely counterbalance the advantages attendant on the use of three-phase transformers. Transformer units should be few in number, and of as large an output as possible, since, although any gain in efficiency by the employment of large units may be inappreciable, simplicity in the arrangement of the sub-station and the reduction of the switchgear required to a minimum are important factors.

Either oil or air-cooled transformers will give good results, particularly if in the former proper means are taken with the larger units for securing the cooling of the oil by circulating cold water through it, or *vice versâ*. The second method has been more generally used in the author's experience. This type of transformer, constructed with sub-divided coils, not only keeps the transformer cool by allowing the forced air to circulate, but renders it more easy to insulate for voltages up to 10,000 with perfect safety. Forced draught cooling involves the use of a blower, which



Curves showing the approximate relative costs of—
1. Rotary converters with transformers and reactance.
2. Synchronous motor-generator sets; motors wound for 6,000 volts.
3. Asynchronous motor-generator sets; motors wound for 6,000 volts.
Sizes, 200 to 500 KW.

FIG. 1.

is usually driven by a small induction motor operating at low pressure. Such types of transformers are capable of giving very large outputs for their weights, and high efficiencies. There is always the risk of breakdown of the induction motor to be reckoned with, a state of affairs which usually ends in the particular bank of transformers concerned being put speedily out of commission.

The natural draught type has much to commend it, as, without a doubt, air blasts, oil or any other cooling devices are somewhat open to objection. Given large radiating surfaces inside and out, combined with ample ventilating spaces through which currents of fresh air can continually pass, this type should give as good results as either of the former.

The following table gives the comparative costs for the various types of a 250-KW. equipment working at 5,500 volts and 50 periods:—

	Three-phase transformers. £ per KW.	Three single-phase transformers. £ per KW.
1. Oil cooled	·8	1·4
2. Cooled by air-blast	·78	1·17
3. Natural cooled	·9	1·5

Switchgear.—Position of Boards.—It will be found convenient to place the high and low tension boards on different galleries, on the same level, with easy means of communication between the two. This arrangement, besides having the advantage of separating the high tension and low tension gear, will facilitate the wiring of the station and avoid any dangerous crossings of the cables.

Type of High Tension Board.—Three distinct types have come within the author's experience, viz., the flat board, the multi-frame, and the cellular or compartment board. The former is quite unsuitable for high pressures; several modifications of this type, however, are in use.

The "multi-frame" type of board may be said to represent very largely the Continental practice, and consists of practically two or more distinct frameworks, the first carrying the marble front on which are mounted the switch handles and instruments worked off transformers. The second framework may be behind or above the former, thus forming a second gallery. This latter carries all the high tension work. This type has the disadvantage of taking up considerable floor space. Next to safety should come efficiency and reliability, and on these points the multi-frame board gives excellent results.

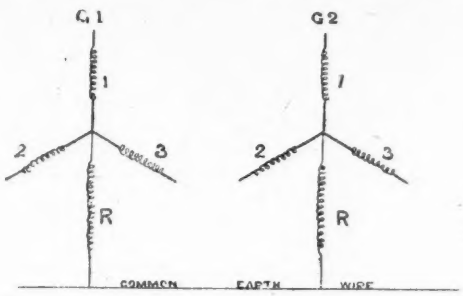
The "cellular and backless" type of board in one of its particular forms is well known in this country. Its arrangement is too severely compact for the higher pressures and powers, and repairs are not easily effected when required, but the saving in floor space is considerable, which is a consideration when sub-station sites are restricted in this respect.

Arrangement of Bus-bars.—Simplicity, as far as it is compatible with reliability of supply, is essential. With a mixed system the

author considers that this is fairly obtained by using one set of bus-bars for lighting and another set for traction, every feeder and every machine being provided with "change-over" or "selector" switches, so that they can be connected up to either set of bus-bars. In effect a set of duplicate bus-bars is thereby provided. In the case of a lighting system only, it is still advisable that a duplicate set of bus-bars should be provided. Such an arrangement is in the author's opinion preferable to the so-called ring systems with disconnecting links.

If fuses be decided on, then two conditions may be laid down as essential:—(1) They must open circuit cleanly and without enabling a rise in potential to take place. (2) They should be severely isolated from the rest of the high tension gear. They should also be in duplicate.

Excessive rises in pressure on interrupting the circuit are not experienced with oil-break fuses, but whether this or the ordinary type be adopted, the employment of spark gaps in addition on the



R, Resistance = four times full load current of generator; G, Generator 1, 2, 3, Phases.

Fig. 2.

system is to be recommended. From the author's recent experience he is inclined to the conclusion that fuses are not to be relied on in extra high pressure work, and that the substitution of an "overload" oil-break automatic switch with time limit and mechanical or electrical control attachment will give the best results. Such an arrangement should be fitted to each high-tension machine in the sub-station, the high-tension feeder ends being connected straight on to the bus-bars, and controlled by automatic oil circuit-breakers of the over-load type at the power house end only.

For the protection of high-tension over-load circuit-breakers in the event of a feeder breaking down, and to ensure their reliable working, the arrangement shown in fig. 2 has been adopted in one or two systems in America, and is to be used on the Metropolitan District Railway, London. Between the centre point of the star winding of the main generator or the sub-station converters and the earth bar, a resistance is inserted which will only carry four times the full load current of the machine. As three-core feeder cables rarely break down between cores, but generally to earth, the amount of current passing can only with this arrangement equal four times the full load current of the generator.

Synchronising.—The tendency appears nowadays to be in the direction of synchronising at the line voltage. There appears to be little to recommend this, and it certainly is desirable on the grounds of safety to work off low-tension synchronising bus-bars.

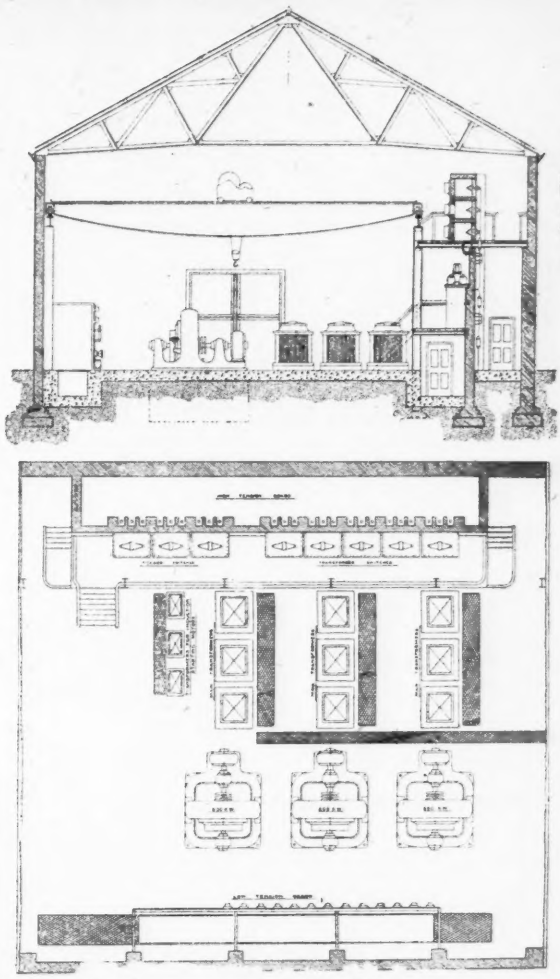


Fig. 3.—Sub-station on the N.E. Railway.

High-tension switchgear appears to be passing through a transition stage; designs seem to be changing almost every year, and nothing can be called standardised in this direction. Probably the design of the future will be one that combines the cellular or compartmental arrangement with remote control.

Examples of Rotary Equipment.

Fig. 3 shows the general arrangement of one of the rotary sub-stations in connection with the electrical equipment of the North-Eastern Railway. The size of rotaries employed is 800 kw. with three-phase connections. All the high-tension gear is placed down

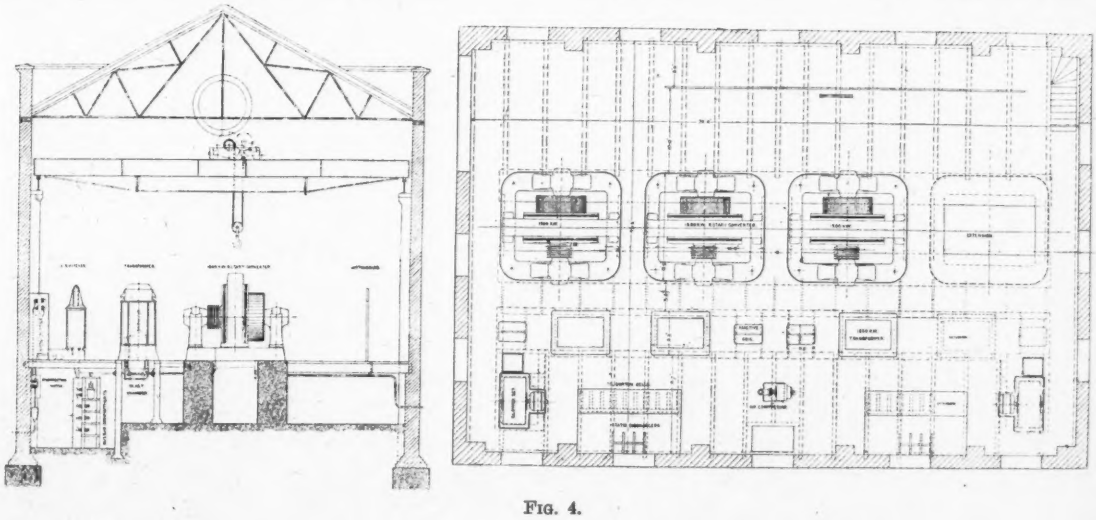


Fig. 4.

Cable Charging Gear.—The author believes that in the majority of cases there is probably no need for this provision, and he would instance the Central London and Glasgow equipments, with high-tension feeders some four to five miles in length. American practice is decidedly opposed to the instalment of this apparatus.

one side of the station, and the low-tension gear on the opposite side, with the rotaries and their accompanying transformers between. The incoming high-pressure feeders are fitted with spark-gaps, provision being made by means of isolating switches to allow of their inspection while the feeder is alive. The feeder switches

are of the oil type, capable of breaking the maximum current of the station, and electrically operated from the low-tension board. In connection with these switches are reverse current relays, which automatically open the switch should the current reverse. The main high-tension bus-bars are placed on the top gallery and enclosed in fire-proof cubicles—the main switches being situated on the intermediate gallery; the fireproof wall supporting the high-tension gear is built of cement blocks, with partitions between each phase and each circuit. Electrically operated switches are placed in the circuit between the high-tension bus-bars and the primaries of the transformers, fitted with time limit over-load cut-outs, the secondaries being connected straight on to the slip-rings of the rotaries. Provision is made for all high-tension circuit breakers to be inspected and cleaned with safety, by means of isolating switches.

The main transformers are of 280 KW. each, with a voltage ratio of 5,500/360, working at a frequency of 40. They are oil insulated, of the self-cooling type, and are connected up in "delta."

The rotaries are started up by means of induction motors mounted on an extension of the armature shaft, separate step-down transformers being provided for the supply to these motors. The machines have an efficiency of 93·44 at three-quarter load to 93·94 per cent. at one-and-a-half times full load.

The low-tension switchboard, besides containing the ordinary panels for operating the direct-current side of the rotaries, comprises the panels for the operation of the oil switches on the high-tension feeders and transformers.

Fig. 4 shows another typical general arrangement for a large capacity rotary sub-station, very similar to the foregoing. The main high-tension bus-bars are, however, placed below ground floor, single three-phase transformers are employed, and the cooling of the latter is effected by means of a separately driven blower set.

Reactance coils are used in conjunction with the rotaries for traction purposes to obtain the compounding effect; these reactance coils would be replaced by induction regulators if the machines were used for lighting purposes. The low tension switchgear is similar in all respects to that of an ordinary direct current station.

The negative pole of the rotary being directly connected to the negative bar and earth without introducing any switch, the secondary of the transformer is permanently earthed through the machine, and forms a safeguard in case the high tension winding of the transformer should break down on the secondary. This arrangement very much simplifies the switchgear, as the equaliser switch is mounted on the rotary itself, the equaliser bar and negative bar being placed in a pit close below the rotaries, leaving only the positive single-pole switch and bus-bar to be placed behind the switchboard proper.

It is preferable that the high tension transformers in sub-stations of this type should be placed in the same room as the rotary converters themselves. It is quite possible for a serious fire to start without the fact being known when the transformers are contained in a separate compartment, whereas, when they are readily seen, they can be cut off from the line on the slightest indication of a fault.

In the sub-stations for the Liverpool and Southport line of the Lancashire and Yorkshire Railway Co.,* the equipment consists of four 600-KW. six-phase rotaries operating at 25 cycles, and producing direct current at 600 to 650 volts.

Three single-phase transformers of 200-KW. capacity connected up in "mesh" are employed for each unit. They are of the air-blast cooled type.

The high and low-tension switchboards are placed together in one long line. Beneath the H.T. portion of the gallery is a fireproof chamber in which the oil switches and other H.T. gear are placed, the whole being worked mechanically by operating levers from the panels above. All instruments are low-tension, being worked through transformers.

(To be concluded.)

BOILER HOUSE ECONOMIES.

By REGINALD S. DOWNE, M.I.E.E., Borough Electrical Engineer, Southport.

(Abstract of paper read at Sheffield, July 1st.)

THE problem is to deliver a unit of electricity at the station bus-bars, with the minimum number of lb. of coal, and this question is the most difficult one the engineer has to face in the power house, but the one most likely to give the best money return for the time expended on it. Coal in some cases accounts for 50 per cent. of the total costs. The great majority of stations burn bituminous slack, costing from 6s. to 12s. per ton delivered in the bunkers. Where the railway rate is high and smoke conditions stringent, Welsh coal is used; in a few cases where it is available, smudge, or low grade fuels are burned. This point is entirely settled by local conditions.

Assuming bituminous slack is used in a well-designed condensing station, with economisers and superheaters, and a load factor not less than 15 per cent, coal ought not to exceed 5 lbs. per unit, including all the losses between the furnace and the engine. Several private industrial plants are now generating a unit of electricity with 3 lbs. of cheap slack. The results are excellent, but under the same conditions one could do better.

It is necessary to have a rigid weekly analysis of units generated, together with coal and water used. It is possible for all to obtain the weekly consumption of coal, and thereby calculate the lb. of coal per unit generated.

The measurement of water is not such a simple matter. Several stations have recently had water meters fixed; in some cases to each boiler, and in others to the main feed ranges. The author tried several types, but found after a few weeks of constant running that water was passing without being recorded.

The Effect of Output and Load Factor.—The stations having the largest outputs and the highest load factors show the best coal results. The coal bill of a station in its early stages, before the output has reached a reasonable figure, is often abnormal, owing to its being ready to supply before there is much demand. The conditions are not favourable to economical running, as the fuel required for banking, keeping steam on ranges, &c., is out of proportion to the output.

The effect of a bad load factor is more pronounced in the boiler house than in the engine room.

With graduated sizes of units it is possible to run the generating plant in a fairly economical manner. If a boiler is overworked, resulting, of course, in inefficiency of the heating surface, the relative loss by radiation is very much reduced.

The number of boilers under steam should be kept to the minimum possible, and some method of assisted draught fitted to help over the peak of the load.

With the class of slack usually burnt, under natural draught, the boiler duty is much lower than the maximum; in many cases the number of boilers under steam could be reduced 25 per cent. The author's station has Lancashire boilers, and the coal for lighting and banking fires in the winter months amounts to between 5 and 7 per cent. of the coal consumed.

Bonus System for Firemen.—The personal factor in the form of the fireman has the greatest influence after output and load factor.

In a test quoted by Mr. Bryan Donkin, four good stokers were put to fire the same boiler—a two-flued 30 ft. Lancashire—under the same conditions. There was a difference between the most and least expert of 23 per cent. in capacity and 18 per cent. in economy, a saving of £7 to £8 per week, with coal at 10s. per ton. The man who actually burns the coal is the one who can effect the economies.

When the engineer has convinced himself that there are no leakages through the brickwork, when the dampers are easily accessible, draught gauges have been fitted to the chimney and each boiler, and a CO_2 recorder has been fixed, he has done all that can be foreseen, and the rest must be left to the leading firemen.

A pecuniary incentive is a great help towards reducing the coal bill. If a central station has not reached what it considers its minimum coal consumption, it is worth while paying at least 2s. to save 20s. worth of coal, which it could not otherwise do. The lb. of coal below which a bonus is given has been fixed for the next financial year at 6·5 lbs. for the summer months, and 5·5 for the winter months.

Superheating.—No practical difficulties are experienced in using a moderate superheat up to 500° F. The saving in coal and steam may amount to between 10 and 20 per cent., and is greater where the engines are working under uneconomical conditions, and where a steam ring is in use, or the steam ranges are inordinately long. A superheater attached to a boiler may abstract 10 per cent. of the heat in the flue gases, and reduce the efficiency of the boiler by this amount; but as this 10 per cent. extra heat in the steam may reduce the engine losses by 20 per cent., the net gain is very great, and alone would warrant adoption. The saving in steam is greater than the saving in coal, due to fuel being required to obtain the superheat.

Many stations are now working with superheaters in side flues, which only increase the temperature some 70° F. The gain in economy, though great, could be increased a further 5 per cent. by raising the superheat an additional 50° F. at the engine.

The author has superheaters fitted in the downtakes of all his Lancashire boilers, and has been able, by adding firebrick combustion chambers, to raise the temperature of the steam leaving the superheaters from 80° F. to 150° F. Superheaters fitted in this way give a fairly constant degree of superheat, and require practically no attention.

The author is of opinion that where a high superheat of constant temperature is required, as in pure turbine stations, separately fired superheaters would be preferable.

Mechanical Stoking and Forced Draught.—To what extent does mechanical stoking influence the coal consumption in central stations? Where the coal has to be thrown into the hoppers by hand there is no saving in labour, and it is doubtful whether any economy can be shown over hand-firing when the interest, repairs, and cost of running are taken into account, while, on the other hand, there may be obvious disadvantages.

A chimney is a rough-and-ready way of inducing the air to flow into the furnaces with sufficient velocity to cause the fuel to burn; it has the merit of being absolutely reliable, and the upkeep is nil. Energy must be expended in bringing the air to the coal, but as a chimney may require 20 per cent. of the heat units in the coal, this work may be carried out much more efficiently by other means.

The apparent advantages of forced draught are:—

1. The steaming power may be increased 30 to 40 per cent. without injury.
2. Higher temperature of combustion, giving a higher evaporative effect for the fuel.
3. Air supply under control.

The furnaces usually fitted by boiler makers are only suitable for burning anthracite coal, or coke. As the majority of boilers burn bituminous coal, the efficiencies are extremely low, but could be raised if the furnaces were designed to suit the class of fuel burned.

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* See illustrations in the ELEC. REV. for April 1st, 1904.

In a coal containing over 10 per cent. of volatile hydro-carbon, a high temperature in the combustion chamber (approx. 1,100° F.) is absolutely necessary for combustion. In most furnaces, when the gases have distilled, they immediately come in contact with water-cooled plates, and are reduced in temperature before combustion takes place. Until the temperature of combustion is raised sufficiently high, the thermal efficiencies of boilers burning this class of fuel will remain in the neighbourhood of 50 per cent.

Fuel Analysis.—It is essential that the quality of the coal used should not be frequently changed, otherwise firemen cannot obtain the best results.

Calorimeter tests of small quantities of coal are not of much commercial value, because the thermal value of bituminous fuel is augmented by the hydro-carbons, a large proportion of which escape up the chimney without parting with their heat. The calorific value of some soft bituminous coal is equal to that of hard South Wales coals, but, in practice, the evaporation is much lower. If we obtain the percentage of moisture under similar weather conditions by drying a known weight of slack, and also ascertain the percentage of ash, it is possible to keep a reasonable check on the deliveries. In the author's opinion evaporation tests made under similar conditions give the best practical results.

Where a contract is placed with a colliery, fewer deviations in quality are to be expected than where supplies are obtained from a coal merchant or colliery agent; where the colliery works only one seam of coal the conditions are even more favourable. Southport has placed a contract with the nearest colliery under the latter conditions, and tests carried out by Mr. J. B. C. Kershaw, F.I.C, on samples delivered over six weeks show the qualities to be practically identical.

Analysis of Flue-Gases.—For a complete analysis of the exit gases from a boiler it is necessary to know their chemical constituents, temperature and the draught. To obtain the greatest boiler efficiency the excess of air must be kept as low as possible, and this can only be ascertained by individual tests, and depends upon the quality of coal and the draught available. Every pound of air which passes through the boiler in excess of the theoretical quantity represents a dead loss, as this air has to be heated up from the temperature of the atmosphere to the temperature of the exit gases. To obtain perfect combustion of the fuel, as much oxygen as possible should combine with the carbon to produce carbonic acid. For practical purposes, the amount of carbonic acid produced is an index to the state of combustion. Under theoretical conditions without excess air, 19 per cent. CO_2 would be produced, but in every-day work one might with reasonable attention obtain 12 per cent. CO_2 with an exit temperature of 600° F. The difference between 8 per cent. and 12 per cent. CO_2 represents a loss of 8·5 per cent. of the fuel burned.

Many works have recently fitted up recording apparatus to ascertain this percentage, and in most cases the results have been eminently satisfactory, and have well justified the outlay.

This arrangement for analysing the gases is more convenient than the "snap" method, and the readings are for all practical purposes correct, but can be checked by direct analysis. It is possible to connect the apparatus to each boiler in turn, and by reducing the air leakages, altering the thickness of fires, &c., to raise the average percentage of CO_2 considerably. Without some apparatus of this character it is not possible to keep a close watch on air leakages. Most boilers are surrounded by a quantity of brickwork which is notoriously porous, and as this brickwork is subjected to great changes of temperature, the air leakage becomes excessive unless it is receiving constant attention. Air leakages being inwards are of an insidious character, as they do not show themselves but have to be searched for.

When boilers are shut down under natural draught, there is always considerable air leakage into the main-flue, even when the dampers are closed. Sliding dampers require to be an easy fit in their frames, but in most cases this is overdone; an improvement on the usual type of damper might be easily fitted. The brickwork round damper-frames is difficult to inspect; generally on being opened up it is found to pass cold air at every joint. This air has a considerable cooling effect on the gases; it decreases the draught and lowers the economiser efficiency. To what extent this cooling is possible, is shown by the following figures taken by the author from a range of six Lancashire boilers, No. 6 being nearest to the economisers.

Boilers Nos. 5 and 6 under steam.

Temperature of exit gases taken in side flues at a point 12 in. on boiler side of dampers.	
Average temperature of exit gases...	729° F.
Average temperature of exit gases in centre of main flue opposite No. 6 boiler	314° F.
Average temperature of gases entering economisers	496° F.
Average temperature of gases leaving economisers	291° F.

The stream of cold air leaking past the four standing boilers passing up the centre of the main flue, and mixing with the hot gases from Nos. 5 and 6 boilers, reduced their temperature 233° in 10 ft. of flue. The fall in temperature through the economisers was only 205°. If it is not possible to prevent these air leakages at the dampers, on shutting a boiler down for any length of time, it is advisable to brick up the furnaces.

The author has had one form of CO_2 recording apparatus fitted in his boiler house for the past eight months, and has found it extremely useful. When first installed it was impossible to get more than from 2 to 3 per cent. CO_2 from certain boilers; on tests he has since obtained 15 to 16 per cent. as a maximum, but the average daily running works out at about 10 per cent.

Auxiliary Plant.—Mechanical stokers, economiser scrapers, coal elevators, and ash conveyers are now generally electrically driven. Most stations, however, still have steam feed pumps, which are notoriously inefficient, and may require from 2½ to 3½ per cent. of the steam generated. With a careful sub-division of electrically driven feed pumps, this may be reduced to 1½ per cent.

Feed Water Purification and Heating.—In every case where water is treated, it should be done externally, before entering the boiler. For economical steaming, a boiler should be clean inside and out, because the transmission of heat is rendered easier, and the evaporation is increased.

It is a generally accepted fact that no economy can be obtained by raising the temperature of feed water except by heat which would be otherwise wasted. Is it possible, by having separately fired feed heaters in series with economisers, to put the water into the boilers at the same temperature as the steam, and so obtain more duty per boiler, and reduce the number under steam, thus effecting a saving in coal? The true function of a boiler would then be steam raising, and not feed heating in addition.

Prevention of Radiation.—When the boilers and piping have been covered with the most suitable material, it is necessary to have the latter periodically examined and repaired, as it is usually of a perishable nature. When it is enclosed in a metallic envelope, much waste may be caused if there is contact between the piping and the shield, which may be at nearly the temperature of the steam. Condensation may be reduced one-half if the valve bodies and flanges are covered. The joint itself may be left exposed, but with superheated steam there is little trouble from leaky joints, if the ranges are well drained.

Conclusions.—Perfect combustion of fuel cannot be obtained in any form of boiler, but it ought to be possible to considerably raise the low thermal efficiencies at which most of them are working at the present time. The two essentials are:—The highest possible initial temperature in the combustion process, as the heat transmission between the water and the hot gases is directly proportional to their difference of temperature; and a high temperature in the combustion chamber, so that the volatile gases are not cooled down before combustion takes place. To obtain full value from bituminous coal is an exceedingly difficult matter, and the numerous papers which have dealt with this problem do not assist us much.

The subject is usually dismissed as follows:—"In a properly constructed furnace these valuable hydrogen units can be utilised to their full value, but time does not permit of going further into this matter." What engineers are seeking is the properly constructed furnace, suitable for the particular class of slack to be burnt.

Electrical engineers have made great progress in this special branch of steam engineering, due in great measure to the fact that they are the largest purveyors of energy in a form which is readily and accurately measured. Before the advent of electricity supply, these investigations were entirely in the hands of marine and water engineers, who were restricted to measuring their energy in indicated horse-power-hours, which is neither a convenient nor particularly accurate method.

Mr. F. A. Newington (Edinburgh), in opening the discussion, expressed his belief in the efficacy of economies at the boiler house end, rather than at the meter end. He did not think much of the bonus system, which should be applied all round, if adopted at all. In regard to mechanical stokers, maintenance was their greatest drawback with high rates of burning. His stokers cost, on an average, 6·68d. per ton of coal burned, from the above cause, although he expected to reduce that figure shortly. The firing and trimming also cost an additional 8·68d. per ton. He thought there was an opening for some automatic means of signalling the emission of smoke from the chimneys. With marine boilers trouble arose through leaky tubes, when induced draught was used, and so he preferred natural draught. It was necessary to consider the expense of installing CO_2 recorders in a large plant.

Mr. Stromeyer emphasised the value of continuous boiler tests, they enabled a knowledge of stand-by losses to be obtained. Boiler house records were also valuable as a source of instruction to the staff. He pointed out that, in regard to bonuses, coal merchants frequently offered an inducement to stokers to burn more coal, but a bonus system, if effective from the manager's point of view, was a valuable means of economising. He recalled that in such a system, a reserve fund of £2 had been instituted for the purpose of meeting any fines incurred for smoke nuisance. In regard to induced-draught marine boiler plants, Messrs. John Brown & Co. were exclusively adopting this type, which was capable of being forced enormously. He did not quite agree with the plan of having the same type of boiler for peak and level loads.

Mr. S. E. Fedden (Sheffield), speaking on the question of mechanical stoking, mentioned that with their marine boilers some four or five years ago, they obtained an evaporation of 11,000 lbs. of water per hour, the efficiency being below 70 per cent. After fitting machine stokers, the evaporation rose to 15,630 lbs. with an efficiency of 72 per cent; the further addition of heated air supply, increased the evaporation to 17,652 lbs., and special tests had shown as much as 18,312 lbs. of water per hour, the efficiency being 79 per cent., whilst 47 lbs. of coal per hour was burnt per sq. ft. of grate area. The steam used for maintaining the draught amounted to 3·5 per cent. of the output.

Mr. Druitt Halpin gave some results obtained at Frankfort Exhibition in regard to decreased efficiency through air leakage, and commended the advantages of live steam heating.

Mr. Kolle (Babcock & Wilcox) thought that CO_2 recorders were good in that they enabled the fireman to see graphically how things

were going on. Bonus systems had proved advantageous, but the bonus must be appreciable if it was to be of use to the fireman. He favoured mechanical stokers, to which the only drawback was the lack of a universal type, and expressed his belief that only those plants where mechanical stokers were adopted could obtain really low fuel costs.

Mr. J. B. C. Kershaw, in the course of some remarks, pointed out that a saving of from 5 per cent. to 12½ per cent. on their costs per unit was open to all engineers who cared to pay more attention to obtaining the best conditions of combustion. He referred to the importance of maintaining the highest possible temperature in the furnaces, a result greatly retarded by excessive air supply; also to the great discrepancy between the actual amounts of CO_2 in the gases—say, between 3 per cent. and 7 per cent.—as compared with the maximum possible, 14 per cent. Contrary to the author's conclusion, he believed that constant sampling and testing of fuels were necessary. In regard to tests for carbonic acid, he inclined to the belief that air leakage in the long connecting pipes was responsible for the low percentages of carbonic acid obtained by Mr. Downe. In concluding, he recommended to engineers a device in use in Belfast for showing the firemen, when at work, the condition of the chimney tops; this merely involved the fixing of a couple of cheap glass mirrors and one or two holes in the roof, so as to reflect the view in the required direction.

Mr. Taite (Salford) referred to the question of mechanical stokers, which he found cost in upkeep and repairs 1·8d. per boiler-hour, or 3½d. per ton of coal burnt. The use of CO_2 recorders had enabled a considerable economy of fuel to be effected in his station. The auxiliary plant at Salford, all electrically driven, took some 5½ per cent. in summer and 7½ per cent. in winter of the total power.

Mr. Sugden thought that the average stoker was underpaid, and that as a result intelligence was lacking—an improvement in this direction would also lead to economy in fuel consumption.

Mr. Downe, in replying, stated that both engine drivers and stokers received the same pay in his station, and he recognised that the latter had the hardest time. The addition of mechanical stokers had increased the evaporation of the boilers at Southport, which was a valuable result.

SIMPLE STORIES.

By "INNOCENS."

5.—Alice in Blunderland.

"The cordon which shields the property of the municipal trader has, for the moment, proved too strong."—Leading Article, Electrical Review, July 8th.

"Good gracious, what was that!" said Alice.

The electric car into which she had been put by the March Hare came to a sudden standstill, and the light went out. At the same moment she heard a shrill voice outside screaming, "You *shan't* come by! You *can't* come by! You *won't* come by! *Shan't! Can't! Won't!*" And she heard the voice of the Baby crying. So she knew that the Queen of Hearts was outside, and that she was in a terrible passion.

The White Rabbit, who was driving the car, tried to argue with the Queen, which is always a foolish thing to do with a lady! "But—oh, my paws and whiskers!—if I don't drive on I don't know what will happen to me! Here's Miss Alice been sent expressly by the March Hare to see the Mad Hatter. Oh my fur and waistcoat, what am I to do?"

"Do what you like, and go where you like," screamed the Queen of Hearts, "so long as you don't come here. Go away, I tell you! Go away! Go away!"

Alice put her head out of the window, intending to say, "Now then! Now then! What's the matter here? Drive on. Stand out of the way there!" You see Alice was very much bigger than the Rabbit or the Queen, and she knew it. But when she looked out she saw that there was Tweedledum and Tweedledee, and the Walrus, and the Carpenter, and several more besides the Queen, all dressed in their very best, with ermine gowns and massive gold chains, and all looking very important. So she said instead, "Hullo! what's this?"

"You can't come here!" screamed the Queen.

"Nohow," said Tweedledum.

"Contrariwise," added Tweedledee.

"Why can't I come here?" retorted Alice, who was getting angry, as little girls do who are crossed.

"Because we say so!" yelled the Queen. Tweedledum and Tweedledee nodded and smiled at each other.

"Who are you?" said Alice scornfully. "You're nothing in size compared to me!"

"We're the Mayor and Corporation," said Tweedledum.

"Big People," said Tweedledee.

"Shall I recite you a little poem about ourselves?" said the Walrus.

"Yes, let him!" entreated the Carpenter.

"Here it is," said the Walrus, beginning to weep:—

> The Mayor and Corporation they decided to oppose
> All tramway schemes supported by Electric Traction Co.'s,
> And they petitioned Parliament to pull the E.T.'s nose . . .

"Shall I go on?" said the Walrus, "There are twenty more verses."

"Say the last verse," replied Alice, who was getting impatient.

> When they petitioned Parliament, Committee chucked 'em out,
> And gave the Tramways Company the right to run about.
> *But* the House gave the Committee *such* a smack upon the snout!

"Ha! ha!" laughed the Queen. "Very good! very good!"

"Very bad, I call it," said Alice. "*Quite* the worst poem I have heard for a long time."

"Well!" said the Walrus, looking hurt, "it's quite as good as anything we've done lately."

"I can quite believe it," said Alice, politely. "Now I've heard the poem, I suppose I can go on."

"Oh, no, you can't!" they all screamed at once.

"I tell you I *must!* I can't stay here all night."

"Then you must go round like I do," sobbed the Walrus, who began slowly to revolve, "round, and round, and round!"

"Oh, don't!" said Alice; "you'll make me giddy!"

"Little girls shouldn't be giddy," said the Carpenter, reprovingly.

"——And if you can't get round that way," added the Walrus, "you must go round, and round, and round—the other way."

Just then the Baby began to cry again, worse than ever.

"Oh, dear!" screamed the Queen, in terror, "I do believe the Baby's got an Idea!"

Everybody crowded round. "It's sure to die, pretty dear!" wept the Walrus. "We've never had an Idea yet in our town that didn't prove fatal," added the Carpenter.

"Nohow," said Tweedledum.

"Contrariwise!" added Tweedledee.

The Baby screamed louder and louder; the Queen laid it on its chest across her knees and spanked it hard to soothe it, till at last the Idea jumped out. (The Idea is a funny little animal of indefinite form, which is often to be found on the table at Council meetings.) Everybody listened eagerly to what it would say.

"Bring a tram of your own," it squeaked in a high voice, "and take Alice across the town in that."

"Good Idea!" shouted everyone, slapping it on the back. In a minute Tweedledum and Tweedledee, who had run away, came back shouting, "Here's our tram! Jump in and we'll turn the current on—much better than yours, more expensive!"

Alice began laughing as soon as she saw it. "Why—it's nothing but an old soap box on wheels! What a silly, silly thing . . . ."

No sooner had she said that, than all the crowd of animals rushed at her. They jumped on her, knocked her down, kicking, struggling, and—

Alice woke.

"What a good thing it was only a nightmare!" said Alice.

THE DISSOCIATION OF CUPRIC SULPHATE AND THE DECOMPOSITION OF ANODES OF COPPER.

By D. TOMMASI.

The remarkable papers published recently by E. Wihlwil in various technical journals, have led me to communicate to your estimable journal certain facts which I had observed some time before with regard to the dissociation of cupric sulphate. I think these facts might be useful in the explanation that scientists have sought to give of the secondary reactions that are generated in the

electrolysis of a solution of cupric sulphate, or of dilute sulphuric acid when an anode of copper is used. This is what I had noticed:—A solution of sulphate of copper, chemically pure, on being raised to boiling point, became agitated, and after a little while precipitated a pale green powder, which was nothing more than basic sulphate of copper. The same effect is observed if we drop some crystals of sulphate of copper (from 10 to 15 grammes) into a litre of distilled water that is boiling fast.

In order to determine what was the quantity of basic sulphate of copper formed in proportion to the dilution of the cupric solution, I made the following experiments:—

I boiled in a flask with a capacity of two litres, furnished with a condenser, a solution containing sulphate of copper, 15 grammes; distilled water, 1,500 grammes. After 7 hours' boiling the quantity of basic sulphate of copper found was ·380 of a gramme.

The solution of sulphate of copper, from which the basic sulphate had been separated, was again heated to boiling point for 3 hours, but the liquid was scarcely disturbed. In order to know whether the basic sulphate of copper left in contact with the solution of sulphate of copper for some time could become partially dissolved, the above experiment was repeated with certain modifications. The solution (15 grammes of sulphate of copper in 1,500 cb. centimetres of distilled water) was boiled for 7 hours, and then left alone.

At the end of three weeks the precipitate of the basic sulphate was collected on a filter. It was then washed and afterwards dried at 100°. The quantity of basic sulphate found was ·356 of a gramme, the difference between this and the preceding experiment being at least ·024 of a gramme.

The liquid from which the basic sulphate had been separated was again brought to boiling point for four hours. After having been left then for 20 hours almost the whole of the liquid was separated from the basic sulphate by decanting, and lastly, the precipitate was collected on a filter. The quantity of basic sulphate found was ·0205 of a gramme. This quantity, deducted from ·024 of a gramme (·004 gramme), represents the weight of the basic sulphate dissolved after three weeks of contact with the sulphate of copper solution. From this it follows that there is no difficulty in allowing the precipitate to fall in the solution during a considerable time (20 to 24 hours), especially if care is taken not to shake the vessel which contains it. Under the same conditions as before, I found the following quantities of basic sulphate of copper:—

				Basic sulphate.
Solution of sulphate of copper at	2	per cent.	...	·731 gramme.
" " "	4	"	...	1·850 "
" " "	8	"	...	2·324 "
" " "	16	"	...	4·702 "
" " "	32	"	...	5 398 "

If we carry out these figures to 100 cubic centimetres of cupric solution, we get:—

				Basic sulphate.
Solution of sulphate of copper at	2	per cent.	...	·048 gramme.
" " "	4	"	...	·122 "
" " "	8	"	...	·155 "
" " "	16	"	...	·313 "
" " "	32	"	...	·360 "

The composition of the basic sulphate varies with the concentration of the cupric solution; it is, as a rule, in proportion to the concentration of the solution. Thus, for instance, the basic sulphate of copper obtained with a solution of sulphate of copper at 1 per cent. contains 52·1 per cent. of copper, whereas that obtained with a solution of sulphate of copper at 8 per cent. contains 61·34 per cent. of copper.

I will observe, in conclusion, that a solution of sulphate of copper, even at an ordinary temperature, is dissolved in the long run with formation of basic sulphate. It is sufficient, in fact, to enclose a solution of cupric sulphate in a stoppered flask, or, better still, in a sealed tube, in order to obtain, at the end of about a year, the formation of a pale green deposit of basic sulphate of copper. From the above observations, might we not attribute, for instance, to the presence of the basic sulphate of copper the deposit that is observed on the copper anode during the electrolysis of sulphate of copper or dilute sulphuric acid?*

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"BATTERY" writes:—"Can a company with a provisional order, or a corporation, refuse to supply electricity for a motor-generator on the cheaper scale, and if so, can they prevent anyone from making a business of charging accumulators off a dynamo? Of course the company or corporation charge accumulators, and have the monopoly for the town for electric supply."

*** The interesting question raised by "Battery" was discussed in this column some time ago. The usual form of provisional order under which electricity is supplied contains a clause which gives the *maximum* charge which the undertakers may make for electricity supplied by them. Subject to that maximum, and to the principle that they must treat their consumers equally, the undertakers may make what charge they please for the energy which they supply. As a general rule, owing to the fact that energy for motive purposes is used during the day time when the generators at the central station are relieved of the lighting load, the undertakers can afford to make a considerable reduction in the price per unit for energy supplied to motors. It is assumed that what "Battery" proposes to do is to take energy at the lower rate for his motor-generator, and so indirectly obtain current for lighting his lamps or for charging accumulators at a considerable saving in cost to himself. The view has already been expressed in this column and is still adhered to, that the undertakers would be quite justified in refusing to supply energy at motor rates when it was to be used in this way.

As to the second question, "Battery" states incidentally that "the corporation has the monopoly for the town for electric supply." This is an erroneous view of the law. No provisional order ever granted has conferred upon an electrical company or a corporation the monopoly of supplying energy in any district. "Battery" has a perfect right to charge accumulators off a dynamo, and to sell the energy so stored to his neighbours.

"A. B." writes:—"I shall be obliged if you will let me know (*a*) whether the manager of the local Electric Supply Syndicate is acting within his powers in executing private wiring and contracting in competition with others whose work he would have to inspect and pass? If not, what is my remedy? (*b*) Does the B.O.T approve of the local supply company passing its own work? (*c*) What is the proper course to take in the event of the local supply company failing to comply with paragraphs 38 and 46, Sec. A, and paragraph 7, Sec. B, of the B.O.T. regulations, Electric Lighting Acts, 1882 and 1888?"

*** With regard to (*a*), there is nothing in the Electric Lighting Acts to prevent the syndicate undertaking the wiring of premises in the manner suggested. If it is allowed by their memorandum and articles of association, it is conceived that no objection could be taken.

With regard to (*b*), whether the Board of Trade approve or not, the Electric Lighting Acts contemplate that undertakers shall make and enforce their own rules. If a consumer were dissatisfied with the rules made by the undertakers, or if he were in a position to show that the wiring put in by an independent contractor was really sufficient, but that the undertakers refused to pass it, he could proceed against the undertakers for refusing to give him a supply.

With regard to (*c*), if the undertakers refuse to comply with any of the rules referred to, "A. B." will be able to proceed against them and recover penalties in a court of summary jurisdiction.

NATIONAL TELEPHONE CO.'S STAFF DINNER.

ON Thursday last week the eleventh annual dinner of the N.T. Co.'s staff took place at the Trocadero, Mr. W. E. L. Gaine, general manager, in the chair. The company numbered about 230, and amongst those present were the Rt. Hon. Sir Henry Fowler, M.P. (President); the Rt. Hon. Lord Harris; Sir Albert Rollit, M.P.; Sir Cuthbert Quilter, Bart., M.P.; Sir J. T. Woodhouse, M.P.; Mr. George Franklin (Vice-President); Mr. C. S. Agnew, and Mr. W. A. Smith. Of the staff, which now numbers over 12,000, there were present Mr. Albert Anns (secretary), Mr. Frank Gill (engineer-in-chief), and the principal officers from the company's head offices and centres throughout the United Kingdom.

The chairman proposed the loyal toasts, which were duly honoured, after which came the toast of "The National Telephone Co." Mr. Gaine, in introducing his annual budget, stated that the company now had in Great Britain and Ireland, 1,095 exchanges, an increase of 45, as compared with the preceding year, and 300,000 subscribers' stations, an increase of 40,000. During the year no fewer than 938,000,000 telephonic messages had been transmitted, at a cost of ·41d. each, showing an increase of 95,000,000; in contrast with this extraordinary traffic, the number of inland telegrams transmitted by the Post Office amounted to only 84,000,000. Mr. Gaine said he was not good at figures—a statement received with cheers—but since the first staff dinner was held 10 years ago, the number of exchanges had increased by 103 per cent.; the number of stations from 80,000 to 300,000, an increase of 275 per cent.; the number of messages dealt with from 245 to 938 millions, an increase of 283 per cent.; and the gross revenue from £750,000 per annum to £2,000,000, while the cost per message had decreased from ·72d. to ·41d.

The company had as usual had many difficulties to contend with during the past year; as to the future, he would say nothing. The telephonic service of this country was now in advance of that of any other European country, though he regretted to say that it was behind that of the United States; that was the fault of those who expected one to make bricks without straw. The company was never in a sounder financial position than at the present time. Regarding its relations with the Post Office, he thought that no settle-

* It would be interesting to find out whether, during the electrolysis of dilute sulphuric acid, with a copper anode, basic sulphate of copper would not be produced at the same time as the neutral sulphate of copper.

ment would prove satisfactory which did not ensure the continued extension and improvement of the telephone service.

Replying for the company, Sir Henry Fowler said that Mr. Gaine had by no means overstated the position of the company. Until recently it had been the best hated company in the kingdom, but of late, thanks to its excellent management and improved service, its unpopularity had subsided. He protested against the manner in which the company had been treated as though it were a national enemy; the company had maintained the telephone service all over the country by capital raised by its unaided efforts, at small profit to itself, and had carried out all the experimental work necessary to the proper development of the system, at great cost to itself. The number of genuine complaints was decreasing, and was infinitesimal in comparison with the enormous scope of the business.

Sir Henry commended the loyal work of the staff, which was indispensable to the maintenance of good service. He knew of *no* competitors who were supplying an efficient service at really cheaper rates. In the United States the telephone companies were not hampered by the law, and the nation readily provided capital, whereas in this country thousands of would-be subscribers were awaiting connection, but could not be connected without further capital. He believed, however, that Parliament and the nation would do fair justice to the company.

Mr. George Frankin also replied, and attributed the success of the undertaking largely to the zeal of the staff, and to the excellent management of Mr. Gaine. The daily Press displayed a remarkable want of knowledge on the subject of telephony, and he was sure that, if it took the trouble to inquire into the matter, its attitude towards the company would be greatly modified. The interests of the staff went hand in hand with those of the shareholders. Less red tape, a fair field, and no favour, were all that the company asked for.

Proposing the health of "The Directors and Other Guests," Mr. W. A. Valentine said that there was a peculiar fascination about the telephone industry, which aroused enthusiasm on the part of its votaries. The complaints to which they were subjected must be considered the penalty of greatness.

Replying, Lord Harris sympathetically referred to the death of Mr. J. S. Forbes, a genial comrade and a business man of remarkable foresight; and Mr. E. Heyworth, who had been in the telephone business from the commencement. Had certain action been taken last month, no doubt all the directors would have disappeared; but he was sure that Mr. Gaine would have remained in office, and most of the staff. The growing tendency of Parliament to check private enterprise was a grave symptom. It should not be forgotten that the prosperity of the country had been built up by private enterprise. He once thought that the telephone service ought to be in the hands of a Government department, but after Mr Gaine's report on his visit to the United States, he had seen reason to doubt his conclusions.

Sir Albert Rollit also replied in his usual humorous vein, and styled Messrs. Gaine, Gill, and Goddard "the three busy Gees." He gave some fatherly advice to the staff, and related a number of stories which were enjoyed by the audience.

Finally, Mr. L H. Lowe proposed the "Health of the Chairman," in eulogistic terms, and Mr. Gaine, whose popularity is unmistakable, briefly replied.

A musical programme was performed during the dinner and between the toasts.

The *camaraderie* of the members of the staff, who all appear to know each other, and to keenly appreciate their annual reunion, left no possibility of the function being otherwise than highly successful and enjoyable.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

4,663A. "Improved means for rupturing electric circuits." P. H. THOMAS. (Date applied for under Patents Act, 1901, June 27th, 1903, being date of application in United States.) An invention comprised in application No. 4,663, dated February 25th, 1904. June 29th. (Complete.)

14,433. "Improvements in electric ignition lighting and battery charging systems, parts of which are applicable for other purposes." I. M. DE HAVILLAND. June 27th.

14,442. "Improved means for electrically connecting railway rails or other conductors." J. S. ALEXANDER. June 27th.

14,460. "Improvements in or relating to the reduction of the difference of phase in electric current circuits." J. Y. JOHNSON. (Badische Anilin and Soda Fabrik, Germany.) June 27th.

14,468. "Improvements in or relating to electro-magnetic apparatus for opening, closing or short-circuiting electric circuits." V. A. FYNN. June 27th.

14,504. "Improvements in and connected with electrolytic cells." J. HARGREAVES. June 28th.

14,510. "Improvements applicable to the 'trolley poles' of electric tramcars." F. NICHOLSON. June 28th.

14,519. "Automatic electric rail protector." H. SANDERSON. June 28th.

14,520. "Improvements in branch connections for electric cables." F. EVERHART and J. J. DOSSERT. June 28th. (Complete.)

14,523. "Telephone systems." W. FAIRWEATHER. (American Electric Telephone Co., United States.) June 28th. (Complete.)

14,526. "Improvements in controller apparatus." P. S. BARRETT. June 28th. (Complete.)

14,543. "Improvements in thermo-electric couples." W. H. BRISTOL. June 28th. (Complete.)

14,544. "Improvements in thermo-electric couples." W. H. BRISTOL. June 28th. (Complete.)

14,545. "Improvements in thermo-electric couples or apparatus." W. H BRISTOL. June 28th. (Complete.)

14,553. "Improvements in electric burglar alarms." A. GETTO. June 28th. (Complete.)

14,567. "Improvements in electricity meters." I. O. REVILLIOD. June 28th.

14,568. "Arrangement of electric cable working with high voltage." SIEMENS SCHUCKERT WERKE G.m.b.H. (Date applied for under Patents Act, 1901, June 29th, 1903, being date of application in Germany.) June 28th. (Complete.)

14,577. "Improvements in liquid lift controllers or resistances for use with either alternating or direct current circuits." E. D. KNIGHTS. June 28th.

14,597. "Improvements in and relating to time switches for electric current, gas light, or similar purposes." F. S. SMITH and J. H. SMITH. June 29th.

14,617. "Improvements in the contacts of electric wire connections." E. LYCETT. June 29th. (Complete.)

14,663. "Improvements in and relating to electro-motor driving." S. Z. DE FERRANTI. June 29th.

14,684. "Improvements in and connected with dynamo-electric machines." H. O. FARRELL. June 30th.

14,717. "Improvements in insulating electric conductors especially suitable for the firing plugs of internal combustion engines." J. LEIGHTON and E. HACKING. June 30th.

14,727. "Improvements in and relating to electric railways." J. C. ANGUS. June 30th.

14,728. "A gravity controlled electric current indicator with a long range of movement." W. J. STILL. June 30th.

14,733. "Improvements in electric arc lamps." E. A. CAROLAN. (The General Electric Co., United States.) June 30th.

14,734. "Improvements in electric arc lamps." E. A. CAROLAN. (The General Electric Co., United States.) June 30th.

14,735. "Improvements in electric arc lamps." E. A. CAROLAN. (The General Electric Co., United States.) June 30th.

14,736. "Improvements in and relating to electric cut-outs and the like." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 30th.

14,737. "Improvements in dynamo-electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 30th.

14,738. "Improvements in dynamo-electric machines. THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 30th.

14,739. "Improvements in brush holders for dynamo electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 30th.

14,740 "Improvements in electric meters." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 30th.

14,743. "Improvements in or connected with electric or other railways." J. E. NEALE. June 30th.

14,761. "Improvements in or relating to driving gear for electrically operated cranes, trolleys, travelling winches and the like." H. J. HADDAN. M. Becker, Germany.) June 30th.

14,762. "Improvements in electro-magnetic operating devices for levers, valves and other mechanism." H. J. HADDAN. (M. Becker, Germany.) June 30th.

14,767. "An improved nipple for use in connection with electrical conduit tubes and fittings." H. HIRST and C. E. GUNNER. July 1st. (Complete.)

14,770. "Improvements in electric light reflectors." H. HIRST and J. H. COLLINGS. July 1st.

14,786. "Improvements in and connected with the supply of electric current to the 'live' rail or wire of electric traction systems." G. W. PEARD and A. M. MARTIN. July 1st.

14,792. "Electric railway automatic feeding appliance." E. ROTHWELL. July 1st.

14,806. "Improvements in books of memorandum forms for telephone messages and holders for same." R. D. COLE. July 1st.

14,814. "Improved clip for clamping or bonding the trolley wires to fittings in overhead wire systems of electric traction." J. H. LUBY and W. HARRIS. July 1st. (Complete.)

14,815. "Improved section insulator for overhead wire systems of electric traction." J. H. LUBY and W. HARRIS. July 1st. (Complete.)

14,821. "Improvements in and relating to electro-capillary apparatus." J. T. ARMSTRONG and A. ORLING. July 1st.

14,829. "A new and improved electro-medical apparatus for the curative treatment of disease." H. C. BRAUN July 1st.

14,841. "Improvements in and relating to the regulation of dynamo-electric machines." ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT. (Date applied for under Patents Act, 1901, July 2nd, 1903, being date of application in Germany.) July 1st. (Complete.)

14,847. "Improvements in electrical fire alarms or thermo-indicators." C. CYON. July 1st (Complete.)

14,879. "Improvements in and relating to apparatus for controlling the lighting and extinguishing of gas, the flow of fluids or the actuation of electric switches, and for analogous uses at pre-determined times." H. W. HARRIS. July 2nd.

14,911. "Improvements in electric arc lamps." A. BELLARDENT. July 2nd. (Date applied for under Patents Act, 1901, September 5th, 1903, being date of application in France.) (Complete.)

14,918. "Improvements in and relating to automatic telegraphic apparatus." A. DAMASKINOS. July 2nd. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

CONTROLLING DEVICES FOR ELECTRIC MOTORS. G. A. K. Kohler. 26,273. December 1st.

SAFETY FUSES FOR ELECTRIC CIRCUITS. J. Y. Johnson. (The Elektricitäts-Aktien-Gesellschaft vormals W. Lahmeyer & Co., Germany.) 26,380. December 2nd.

MAGNETO-ELECTRIC IGNITION DEVICES FOR INTERNAL COMBUSTION ENGINES. F. Masson. 26,659. December 5th.

ELECTRICALLY OPERATED RAILWAY SWITCHES. C. W. Breedlove and R. R. Grant. 26,783. December 7th.

ELECTRIC SANITARY CLOSETS. J. H. Wilson. 26,792. December 7th.

TELEPHONE SYSTEMS. W. Fairweather. (The Stromberg Carlson Telephone Manufacturing Co., United States). 26,849. December 8th.

SWITCHING MECHANISM FOR DOUBLE FILAMENT ELECTRIC LAMPS. J. McCullough. 26,961. December 9th. (Date applied for under Patents Act, 1902, December, 10th, 1902, being date of application in United States.)

WINDING MOVING COILS FOR ELECTRIC MEASURING INSTRUMENTS. R. O Heinrich. 27,213. December 11th.